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SUBSTITUTED PIPERIDINE COMPOUNDS USEFUL AS MODULATORS OF CHEMOKINE RECEPTOR ACTIVITY

The present invention relates to substituted piperidine compounds, processes for their preparation, pharmaceutical compositions containing them and their use in therapy.

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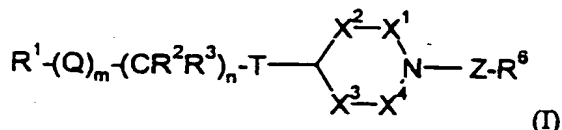
Chemokines play an important role in immune and inflammatory responses in various diseases and disorders, including asthma and allergic diseases, as well as autoimmune pathologies such as rheumatoid arthritis and atherosclerosis. These small secreted molecules are a growing superfamily of 8-14 kDa proteins characterised by a conserved
10 four cysteine motif. The chemokine superfamily can be divided into two main groups exhibiting characteristic structural motifs, the Cys-X-Cys (C-X-C) and Cys-Cys (C-C) families. These are distinguished on the basis of a single amino acid insertion between the NH-proximal pair of cysteine residues and sequence similarity.

15 The C-X-C chemokines include several potent chemoattractants and activators of neutrophils such as interleukin-8 (IL-8) and neutrophil-activating peptide 2 (NAP-2).

The C-C chemokines include potent chemoattractants of monocytes and lymphocytes but not neutrophils such as human monocyte chemotactic proteins 1-3 (MCP-1, MCP-2 and
20 MCP-3), RANTES (Regulated on Activation, Normal T Expressed and Secreted), eotaxin and the macrophage inflammatory proteins 1 α and 1 β (MIP-1 α and MIP-1 β).

Studies have demonstrated that the actions of the chemokines are mediated by subfamilies of G protein-coupled receptors, among which are the receptors designated CCR1, CCR2,
25 CCR2A, CCR2B, CCR3, CCR4, CCR5, CCR6, CCR7, CCR8, CCR9, CCR10, CXCR1, CXCR2, CXCR3 and CXCR4. These receptors represent good targets for drug development since agents which modulate these receptors would be useful in the treatment of disorders and diseases such as those mentioned above.

30 The present invention provides a compound of formula (I):



wherein

Z is CR^4R^5 , C(O) or $CR^4R^5-Z^1$;

Z^1 is C_{1-4} alkylene (such as CH_2), C_{2-4} alkenylene (such as $CH=CH$) or $C(O)NH$;

5 R^1 represents a C_1 - C_{12} alkyl group optionally substituted by one or more substituents independently selected from cyano, hydroxyl, C_1 - C_6 alkoxy (such as methoxy or ethoxy), C_1 - C_6 alkylthio (such as methylthio), C_3 - C_7 cycloalkyl (such as cyclopropyl), C_1 - C_6 alkoxy carbonyl (such as methoxycarbonyl) and phenyl (itself optionally substituted by one or more of halogen, nitro, cyano, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl (such as CF_3), phenyl(C_1 - C_6 alkyl) (such as benzyl), C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy, $S(O)_2(C_1$ - C_6 alkyl), $C(O)NH_2$,
10 carboxy or C_1 - C_6 alkoxy carbonyl); or

R^1 represents C_2 - C_6 alkenyl optionally substituted by phenyl (itself optionally substituted by one or more of halogen, nitro, cyano, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, phenyl(C_1 - C_6 alkyl), C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy, $S(O)_2(C_1$ - C_6 alkyl), $C(O)NH_2$, carboxy or C_1 - C_6

15 alkoxy carbonyl); or

R^1 represents a 3- to 14-membered saturated or unsaturated ring system which optionally comprises up to two ring carbon atoms that form carbonyl groups and which optionally further comprises up to 4 ring heteroatoms independently selected from nitrogen, oxygen and sulphur, wherein the ring system is optionally substituted by one or more substituents
20 independently selected from: halogen, cyano, nitro, oxo, hydroxyl, C_1 - C_6 alkyl, C_1 - C_6 hydroxyalkyl, C_1 - C_6 haloalkyl, C_{1-6} alkoxy(C_1 - C_6 alkyl), C_3 - C_7 cycloalkyl(C_1 - C_6 alkyl), C_1 - C_6 alkylthio(C_1 - C_6 alkyl), C_1 - C_6 alkylcarbonyloxy(C_1 - C_6 alkyl), C_1 - C_6 alkyl $S(O)_2(C_1$ - C_6 alkyl), aryl(C_1 - C_6 alkyl), heterocyclyl(C_1 - C_6 alkyl), aryl $S(O)_2(C_1$ - C_6 alkyl), heterocyclyl $S(O)_2(C_1$ - C_6 alkyl), aryl(C_1 - C_6 alkyl) $S(O)_2$, heterocyclyl(C_1 - C_6 alkyl) $S(O)_2$,
25 C_2 - C_6 alkenyl, C_1 - C_6 alkoxy, carboxy-substituted C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy, C_1 - C_6 hydroxyalkoxy, C_1 - C_6 alkylcarboxy-substituted C_1 - C_6 alkoxy, aryloxy, heterocycliloxy, C_1 - C_6 alkylthio, C_3 - C_7 cycloalkyl(C_1 - C_6 alkylthio), C_3 - C_6 alkynylthio, C_1 - C_6 alkylcarbonylamino, C_1 - C_6 haloalkylcarbonylamino, SO_3H , $-NR^7R^8$, $-C(O)NR^{23}R^{24}$, $S(O)_2NR^{18}R^{19}$, $S(O)_2R^{20}$, $R^{25}C(O)$, carboxyl, C_1 - C_6 alkoxy carbonyl, aryl and heterocyclyl;
30 wherein the foregoing aryl and heterocyclyl moieties are optionally substituted by one or

more of halogen, oxo, hydroxy, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxycarbonyl;

m is 0 or 1;

5 Q represents an oxygen or sulphur atom or a group NR⁹, C(O), C(O)NR⁹, NR⁹C(O) or CH=CH;

n is 0, 1, 2, 3, 4, 5 or 6 provided that when n is 0, then m is 0;

each R² and R³ independently represents a hydrogen atom or a C₁-C₄ alkyl group, or (CR²R³)_n represents C₃-C₇ cycloalkyl optionally substituted by C₁-C₄ alkyl;

10 T represents a group NR¹⁰, C(O)NR¹⁰, NR¹¹C(O)NR¹⁰ or C(O)NR¹⁰NR¹¹;

X¹, X², X³ and X⁴ are, independently, CH₂, CHR¹² {wherein each R¹² is, independently, C₁-C₄ alkyl or C₃-C₇ cycloalkyl(C₁-C₄ alkyl)} or C=O; or, when they are CHR¹², the R¹² groups of X¹ and X³ or X⁴, or, X² and X³ or X⁴ join to form a two or three atom chain which is CH₂CH₂, CH₂CH₂CH₂, CH₂OCH₂ or CH₂SCH₂; provided always that at least two
15 of X¹, X², X³ and X⁴ are CH₂;

R⁴ and R⁵ each independently represent a hydrogen atom or a C₁-C₄ alkyl group;

R⁶ is aryl or heterocyclyl, both optionally substituted by one or more of: halogen, cyano, nitro, oxo, hydroxyl, C₁-C₈ alkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ haloalkyl, C₁-C₆ alkoxy(C₁-C₆ alkyl), C₃-C₇ cycloalkyl(C₁-C₆ alkyl), C₁-C₆ alkylthio(C₁-C₆ alkyl), C₁-C₆

20 alkylcarbonyloxy(C₁-C₆ alkyl), C₁-C₆ alkylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl), heterocyclyl(C₁-C₆ alkyl), arylS(O)₂(C₁-C₆ alkyl), heterocyclylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl)S(O)₂, heterocyclyl(C₁-C₆ alkyl)S(O)₂, C₂-C₆ alkenyl, C₁-C₆ alkoxy, carboxy-substituted C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ hydroxyalkoxy, C₁-C₆ alkylcarboxy-substituted C₁-C₆ alkoxy, aryloxy, heterocyclioxy, C₁-C₆ alkylthio, C₃-C₇ cycloalkyl(C₁-
25 C₆ alkylthio), C₃-C₆ alkynylthio, C₁-C₆ alkylcarbonylamino, C₁-C₆ haloalkylcarbonylamino, SO₃H, -NR¹⁶R¹⁷, -C(O)NR²¹R²², S(O)₂NR¹³R¹⁴, S(O)₂R¹⁵, R²⁶C(O), carboxyl, C₁-C₆ alkoxycarbonyl, aryl and heterocyclyl; wherein the foregoing aryl and heterocyclyl moieties are optionally substituted by one or more of halogen, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy,
30 S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxycarbonyl;

$R^7, R^8, R^9, R^{10}, R^{11}, R^{13}, R^{14}, R^{16}, R^{17}, R^{18}, R^{19}, R^{21}, R^{22}, R^{23}$ and R^{24} are, independently hydrogen, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, C_1 - C_6 hydroxyalkyl, C_3 - C_7 cycloalkyl, C_3 - C_7 cycloalkyl(C_1 - C_4 alkyl) or phenyl(C_1 - C_6 alkyl); and,

R^{15} and R^{20} are, independently, C_1 - C_6 alkyl, C_1 - C_6 hydroxyalkyl, C_3 - C_6 cycloalkyl, C_3 - C_7 cycloalkyl(C_1 - C_4 alkyl) or C_1 - C_6 alkyl optionally substituted by phenyl;

R^{25} and R^{26} are, independently, C_1 - C_6 alkyl or phenyl (optionally substituted by one or more of halogen, nitro, cyano, C_1 - C_6 alkyl, C_1 - C_6 haloalkyl, phenyl(C_1 - C_6 alkyl), C_1 - C_6 alkoxy, C_1 - C_6 haloalkoxy, $S(O)_2$ (C_1 - C_6 alkyl), $C(O)NH_2$, carboxy or C_1 - C_6 alkoxycarbonyl);

or a pharmaceutically acceptable salt thereof, or solvate thereof, or a solvate of a salt thereof;

provided that when T is $C(O)NR^{10}$ and R^1 is optionally substituted phenyl then n is not 0.

Certain compounds of formula (I) are capable of existing in isomeric forms (for example as tautomers, enantiomers, geometric isomers or diastereomers). The present invention encompasses all such isomers and mixtures thereof in all proportions.

Hydroxyalkyl is, for example, 2-hydroxyeth-1-yl. Haloalkyl is, for example, CF_3 . Alkoxy is, for example, methoxy or ethoxy. Alkoxy(C_1 - C_6 alkyl) is, for example, methoxymethyl or ethoxyethyl. Cycloalkyl is, for example, cyclopropyl or cyclohexyl. Cycloalkyl(C_1 - C_6 alkyl) is, for example, cyclopropylmethyl. Alkylthio is, for example, methylthio or ethylthio. Alkylthio(C_1 - C_6 alkyl) is, for example, methylthiomethyl. Alkylcarbonyloxy(C_1 - C_6 alkyl) is, for example, $CH_3C(O)OCH_2$. $S(O)_2$ (alkyl) is, for example, $CH_3S(O)_2$. Alkyl $S(O)_2$ (C_1 - C_6 alkyl) is, for example, $CH_3S(O)_2CH_2$. Aryl(C_1 - C_6 alkyl) is, for example, benzyl, 2-phenyleth-1-yl or 1-phenyleth-1-yl. Heterocyclyl(C_1 - C_6 alkyl) is, for example, heterocyclylmethyl. Aryl $S(O)_2$ (C_1 - C_6 alkyl) is, for example, phenyl $S(O)_2CH_2$. Heterocyclyl $S(O)_2$ (C_1 - C_6 alkyl) is, for example, heterocyclyl $S(O)_2CH_2$. Aryl(C_1 - C_6 alkyl) $S(O)_2$ is, for example, benzyl $S(O)_2$. Heterocyclyl(C_1 - C_6 alkyl) $S(O)_2$ is, for example, heterocyclyl $CH_2S(O)_2$. Alkenyl is, for example, vinyl or allyl. Carboxy-substituted C_1 - C_6 alkoxy is, for example, $HOC(O)CH_2CH_2O$. Haloalkoxy is, for example, OCF_3 . Hydroxyalkoxy is, for example, $HOCH_2CH_2O$. Alkylcarboxy-substituted C_1 - C_6 alkoxy is, for example, $CH_3OC(O)CH_2CH_2O$. Aryloxy is, for example, phenoxy.

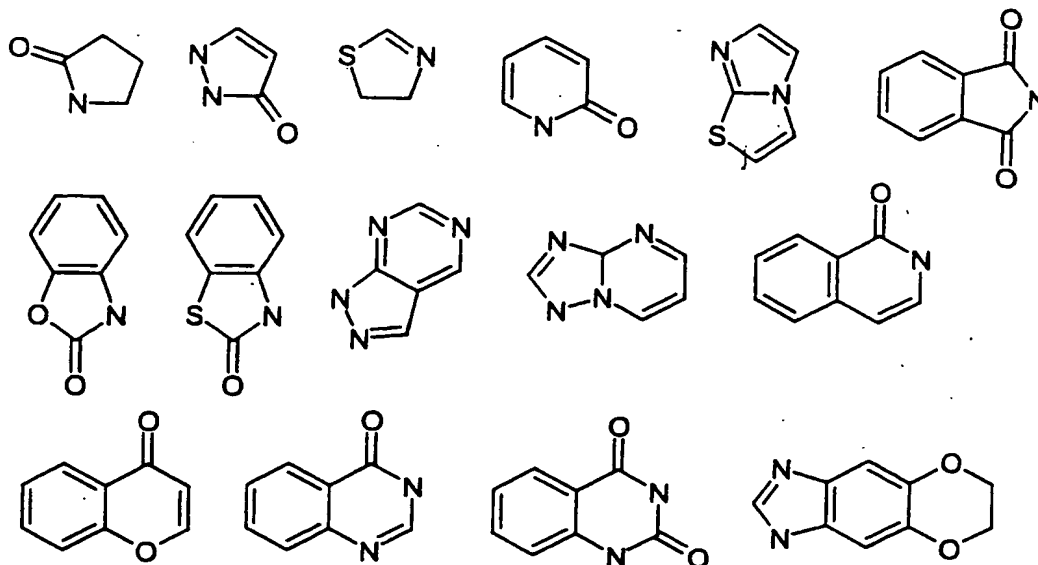
Heterocyclyloxy is, for example, pyridinyloxy or pyrimidinyloxy. C_3 - C_7 cycloalkyl(C_1 - C_6 alkylthio) is, for example, cyclopropyl CH_2S . Alkynylthio is, for example, propargylthio. Alkylcarbonylamino is, for example, acylamino. Haloalkylcarbonylamino is, for example, $ClCH_2C(O)NH$. Alkoxy carbonyl is, for example, $CH_3OC(O)$.

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Aryl is a carbocyclic aromatic ring optionally fused to one or more carbocyclic rings. Aryl is, for example, phenyl, naphthyl or indanyl.

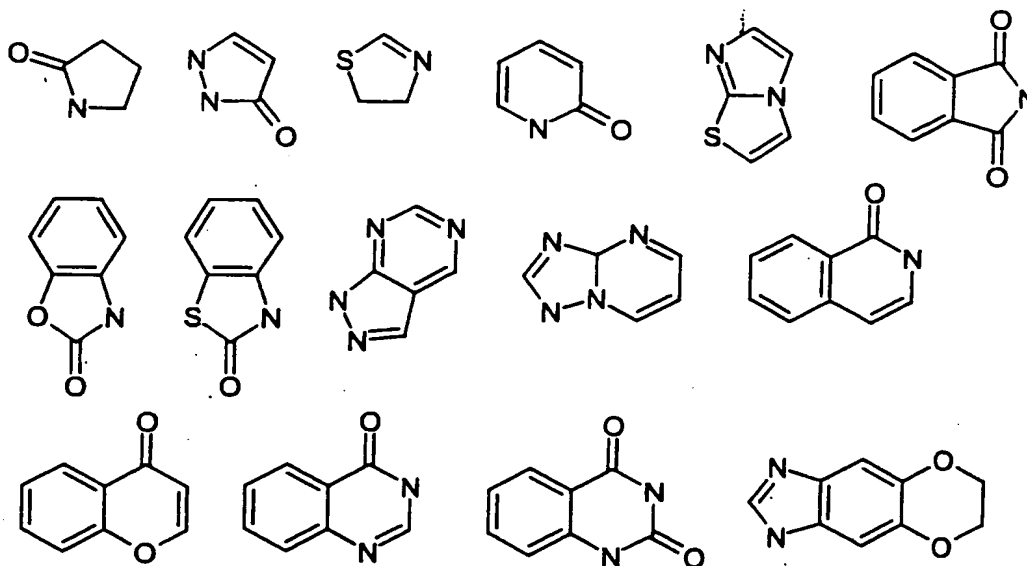
Heterocyclyl is an aromatic or non-aromatic ring system preferably comprising up to 6 (preferably up to 4) heteroatoms selected from the group comprising nitrogen, oxygen and sulphur, and preferably comprising one, two or three 5- or 6-membered rings.

Heterocyclyl is, for example, furyl, thienyl, pyrrolyl, 2,5-dihydropyrrolyl, thiazolyl, pyrazolyl, oxazolyl, isoxazolyl, imidazolyl, 1,2,4-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2,3-triazolyl, 1,2,4-triazolyl, tetrazolyl, pyrrolidinyl, piperidinyl, piperazinyl, morpholinyl, 15 pyridinyl (for example 2-pyridinyl, 3-pyridinyl or 4-pyridinyl), pyrimidinyl (for example 2-pyrimidinyl or 4-pyrimidinyl), pyrazinyl, pyridazinyl, indolyl, 2,3-dihydroindolyl, benzo[b]furyl, benz[b]thienyl, 2,3-dihydrobenz[b]thienyl (for example 1-dioxo-2,3-dihydrobenz[b]thienyl), benzimidazolyl, benztriazolyl, benzoxazolyl, benzthiazolyl, 2,3-dihydrobenzthiazolyl (for example 2,3-dihydrobenzthiazol-2-onyl which is also known as 20 2-oxo-1,3-benzothiazol-3(2H)-yl), 1,2,3-benzothiadiazolyl, 1,2,3-benzoxadiazolyl, 2,1,3-benzothiadiazolyl, 2,1,3-benzoxadiazolyl, quinoxaliny, dihydro-1-benzopyryliumyl (for example a coumarinyl or a chromenonyl), 1,3-benzodioxolyl (also known as 1,2-methylenedioxyphenyl), 3,4-dihydro-1H-2,1-benzothiazinyl (for example 2-dioxo-3,4-dihydro-1H-2,1-benzothiazinyl), purine (for example 1H-purine or 9H-purine), 1H-25 pyrazolo[3,4-d]pyrimidinyl, thieno[2,3-d]pyrimidinyl, thieno[3,2-d]pyrimidinyl, quinolinyl (for example 2-quinolinyl, 3-quinolinyl or 4-quinolinyl), isoquinolinyl, quinazoliny or dibenzothiophenyl; or a ring as shown below:

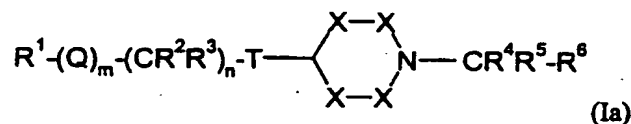


The group R^1 may represent an optionally substituted 3- to 14-membered (especially 5- to 10-membered) saturated or unsaturated ring system which optionally comprises one or two ring carbon atoms that form carbonyl groups and which optionally further comprises one, two, three or four ring heteroatoms independently selected from nitrogen, oxygen and sulphur. Examples of R^1 ring systems, which can be monocyclic or polycyclic, include cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, phenyl, naphthyl, indanyl, furyl, thienyl, pyrrolyl, 2,5-dihydropyrrolyl, thiazolyl, pyrazolyl, oxazolyl, isoxazolyl, imidazolyl, 1,2,4-oxadiazolyl, 1,3,4-oxadiazolyl, 1,2,3-triazolyl, 1,2,4-triazolyl, tetrazolyl, pyrrolidinyl, piperidinyl, piperazinyl, morpholinyl, pyridinyl (for example 2-pyridinyl, 3-pyridinyl or 4-pyridinyl), pyrimidinyl (for example 2-pyrimidinyl or 4-pyrimidinyl); pyrazinyl, pyridazinyl, indolyl, 2,3-dihydroindolyl, benzo[b]furyl, benz[b]thienyl, 2,3-dihydrobenz[b]thienyl (for example 1-dioxo-2,3-dihydrobenz[b]thienyl), benzimidazolyl, benztriazolyl, benzoxazolyl, benzthiazolyl, 2,3-dihydrobenzthiazolyl (for example 2,3-dihydrobenzthiazol-2-onyl which is also known as 2-oxo-1,3-benzothiazol-3(2H)-yl), 1,2,3-benzothiadiazolyl, 1,2,3-benzoxadiazolyl, 2,1,3-benzothiadiazolyl, 2,1,3-benzoxadiazolyl, quinoxalyl, dihydro-1-benzopyryliumyl (for example a coumarinyl or a chromenonyl), 1,3-benzodioxolyl (also known as 1,2-methylenedioxyphenyl), 3,4-dihydro-1H-2,1-benzothiazinyl (for example 2-dioxo-3,4-dihydro-1H-2,1-benzothiazinyl), purine (for example 1H-purine or 9H-purine), 1H-pyrazolo[3,4-d]pyrimidinyl, thieno[2,3-

d]pyrimidinyl, thieno[3,2-d]pyrimidinyl, quinolinyl (for example 2-quinolinyl, 3-quinolinyl or 4-quinolinyl), isoquinolinyl, quinazolinyl or dibenzothiophenyl; or a ring as shown below:



5 In one aspect the present invention provides a compound of formula (Ia):



wherein

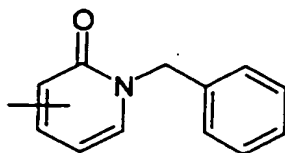
R^1 represents a C_1 - C_{12} alkyl group optionally substituted by one or more substituents independently selected from cyano, hydroxyl, C_1 - C_6 alkoxy, C_1 - C_6 alkylthio and

10 C_1 - C_6 alkoxy-carbonyl, or

R^1 represents a 3- to 10-membered saturated or unsaturated ring system which optionally comprises up to two ring carbon atoms that form carbonyl groups and which optionally further comprises up to 4 ring heteroatoms independently selected from nitrogen, oxygen and sulphur, wherein the ring system is optionally substituted by one or more substituents

15 independently selected from halogen, cyano, nitro, hydroxyl, carboxyl, C_1 - C_6 alkyl, C_1 - C_6 hydroxyalkyl, C_1 - C_6 haloalkyl, C_1 - C_6 alkoxy, carboxy-substituted C_1 - C_6 alkoxy, C_1 - C_6 alkylthio, C_1 - C_6 alkylthiomethyl, C_1 - C_6 alkylcarbonylamino, $-NR^7R^8$, $-C(O)NR^7R^8$, C_1 - C_6

alkylcarbonyloxymethyl, C₁-C₆ alkoxy carbonyl, C₁-C₆ alkoxy carbonyl piperazinyl, furyl, phenyl, pyridinyl, pyrazinyl, halophenyl, thienyl, thienylmethyl, C₁-C₆ alkylbenzyl and



m is 0 or 1;

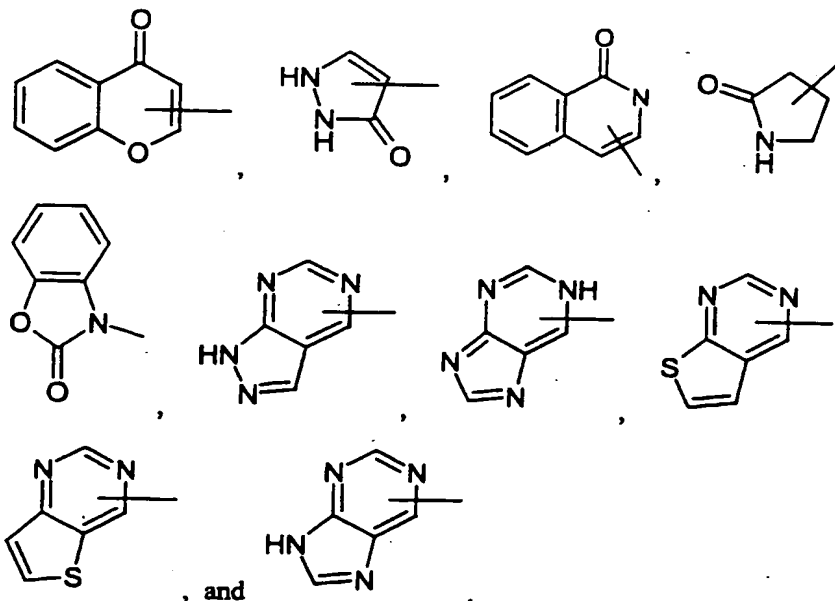
- 5 Q represents an oxygen or sulphur atom or a group NR⁹, C(O), C(O)NR⁹ or NR⁹C(O);
 n is 0, 1, 2, 3 or 4, provided that when n is 0, then m is 0;
 each R² and R³ independently represents a hydrogen atom or a C₁-C₄ alkyl group;
 T represents a group NR¹⁰, C(O)NR¹⁰ or NR¹¹C(O)NR¹⁰;
 each X independently represents a group CH₂, CHR¹² or C=O, provided that at least two
 10 groups X simultaneously represent CH₂;
 R⁴ and R⁵ each independently represent a hydrogen atom or a C₁-C₄ alkyl group;
 R⁶ represents a phenyl group optionally substituted by one or more substituents
 independently selected from halogen, amino (-NH₂), nitro, cyano, sulphonyl (-SO₃H),
 sulphonamido (-SO₂NH₂), C₁-C₆ alkyl, C₁-C₆ haloalkoxy and C₁-C₆ alkylsulphonyl;
 15 R⁷ and R⁸ each independently represent a hydrogen atom or a group selected from
 C₁-C₆ hydroxyalkyl, C₃-C₆ cycloalkyl and C₁-C₆ alkyl optionally substituted by phenyl; R⁹,
 R¹⁰ and R¹¹ each independently represent a hydrogen atom, or a C₁-C₄ alkyl or
 cyclopropylmethyl group; and
 each R¹² independently represents a C₁-C₄ alkyl or cyclopropylmethyl group;
 20 or a pharmaceutically acceptable salt or solvate thereof.

In the context of the present specification, unless otherwise indicated an alkyl substituent
 or an alkyl moiety in a substituent group may be linear or branched. Examples of alkyl
 groups/moieties containing up to twelve carbon atoms include methyl, ethyl, n-propyl, iso-
 25 propyl, n-butyl, iso-butyl, tert-butyl, n-pentyl, n-hexyl, n-heptyl, n-octyl, n-nonyl, n-decyl,
 n-undecyl and n-dodecyl groups. A C₁-C₆ hydroxyalkyl group will comprise at least one
 hydroxyl group (e.g. one, two or three hydroxyl groups) which may be attached to an
 internal or terminal carbon atom of the alkyl chain. Similarly, a carboxy-substituted
 C₁-C₆ alkoxy group will comprise at least one carboxyl group (e.g. one, two or three

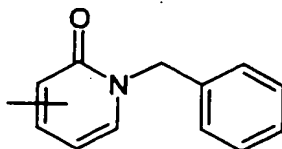
carboxyl groups) which may be attached to an internal or terminal carbon atom of the alkyl chain. A C₁-C₆ haloalkyl or C₁-C₆ haloalkoxy group will comprise at least one halogen atom (e.g. one, two, three or four halogen atoms independently selected from fluorine, chlorine, bromine and iodine) which may be attached to an internal or terminal carbon atom of the alkyl chain. A halophenyl group will comprise from 1 to 5 halogen atoms independently selected from fluorine, chlorine, bromine and iodine. A C₁-C₆ alkylbenzyl group will comprise at least one C₁-C₆ alkyl group (e.g. one, two or three C₁-C₆ alkyl groups) attached to the phenyl ring of the benzyl moiety. If there is more than one C₁-C₆ alkyl group attached to the phenyl ring, the groups may be the same or different. In a C₁-C₆ alkoxycarbonylpiperazinyl substituent group, the piperazinyl moiety is attached through a nitrogen atom to the carbonyl moiety. When T represents C(O)NR⁹, it should be understood that the nitrogen atom is attached directly to the six-membered heterocyclic ring in formula (I).

15 The group R¹ may represent a C₁-C₁₂, preferably C₁-C₁₀, more preferably C₁-C₆, alkyl group optionally substituted by one or more (e.g. one, two, three or four) substituents independently selected from cyano, hydroxyl, C₁-C₆, preferably C₁-C₄, alkoxy, C₁-C₆, preferably C₁-C₄, alkylthio and C₁-C₆ alkoxycarbonyl, preferably C₁-C₄ alkoxycarbonyl.

20 The group R¹ may alternatively represent an optionally substituted 3- to 10-membered saturated or unsaturated ring system which optionally comprises one or two ring carbon atoms that form carbonyl groups and which optionally further comprises one, two, three or four ring heteroatoms independently selected from nitrogen, oxygen and sulphur. Examples of ring systems that may be used which can be monocyclic or polycyclic include
25 cyclopropyl, cyclobutyl, cyclopentyl, cyclohexyl, phenyl, pyrazolyl, furyl, thienyl, imidazolyl, quinolinyl (e.g. 2-quinolinyl, 3-quinolinyl or 4-quinolinyl), pyridinyl (e.g. 2-pyridinyl, 3-pyridinyl or 4-pyridinyl), 1,3-benzodioxolyl, thiazolyl, benzimidazolyl, oxadiazolyl (e.g. 1,2,4-oxadiazolyl), triazolyl (such as 1,2,3-triazolyl or 1,2,4-triazolyl), benzothiazolyl, pyrimidinyl (e.g. 2-pyrimidinyl or 4-pyrimidinyl), benzothieryl,



- 5 In a further aspect of the invention the ring system of R¹ may be optionally substituted by one or more (e.g. one, two, three or four) substituents independently selected from halogen (e.g. fluorine, chlorine, bromine or iodine); cyano; nitro; hydroxyl; carboxyl; C₁-C₆, preferably C₁-C₄, alkyl (especially methyl or ethyl); C₁-C₆, preferably C₁-C₄, hydroxyalkyl; C₁-C₆, preferably C₁-C₄, haloalkyl (e.g. trifluoromethyl); C₁-C₆, preferably C₁-C₄, alkoxy (especially methoxy, ethoxy, n-propoxy or isopropoxy); carboxy-substituted C₁-C₆, preferably C₁-C₄, alkoxy; C₁-C₆, preferably C₁-C₄, alkylthio (especially methylthio, ethylthio, n-propylthio and tert-butylthio); C₁-C₆, preferably C₁-C₄, alkylthiomethyl (particularly methylthiomethyl); C₁-C₆, preferably C₁-C₄, alkylcarbonylamino (especially methylcarbonylamino); -NR⁷R⁸; -C(O)NR⁷R⁸; C₁-C₆, preferably C₁-C₄,
 10 alkylcarbonyloxymethyl (particularly methylcarbonyloxymethyl); C₁-C₆, preferably C₁-C₄, alkoxy carbonyl (especially methoxycarbonyl or ethoxycarbonyl); C₁-C₆, preferably C₁-C₄, alkoxy carbonyl piperazinyl; furyl; phenyl; pyridinyl; pyrazinyl; halophenyl (especially chlorophenyl); thienyl; thienylmethyl; C₁-C₆, preferably C₁-C₄, alkylbenzyl (particularly methylbenzyl); and
 15



In a further aspect R^1 is an aromatic 5-membered heterocyclyl having 2, 3 or 4 ring nitrogen atoms (for example 1,2,4-triazole, 1,2,4-oxadiazole, 1,3,4-oxadiazole or tetrazole) substituted by one heteroaromatic ring (such as pyridine or pyrazole) which is itself optionally substituted by halogen or C_1 - C_4 alkyl; or R^1 is halophenyl (for example phenyl optionally substituted (such as in the 4-position) by fluoro or chloro; such as 4-chlorophenyl or 4-fluorophenyl).

10 In a further aspect of the invention Q is oxygen or m is 0. In another aspect of the invention Q represents a sulphur atom or a group NH, C(O) or NHC(O).

In yet another aspect of the invention n is 1 or 2.

15 In a further aspect of the invention T represents a group NH, C(O)NH or NHC(O)NH. In another aspect of the invention T represents a NH or C(O)NH group. In a further aspect T is C(O)NH.

In one aspect X^1 , X^2 , X^3 and X^4 are all CH_2 or CHR^{12} , wherein the R^{12} groups of X^1 and X^3 or X^4 , or, X^2 and X^3 or X^4 join to form CH_2CH_2 ; provided always that at least two of X^1 , X^2 , X^3 and X^4 are CH_2 . In a still further aspect X^1 , X^2 , X^3 and X^4 are all CH_2 . Preferably, all four groups X represent CH_2 .

It is preferred that each R^2 and R^3 independently represents a hydrogen atom or a methyl group, especially a hydrogen atom.

In one aspect R^4 and R^5 are hydrogen or C_1 - C_4 alkyl. In another aspect R^4 and R^5 preferably each represent a hydrogen atom.

In another aspect of the invention R⁶ represents a phenyl group optionally substituted by one or more (e.g. one, two, three or four) substituents independently selected from halogen (e.g. fluorine, chlorine, bromine or iodine), amino, nitro, cyano, sulphonyl, sulphonamido, C₁-C₆, preferably C₁-C₄, alkyl, C₁-C₆, preferably C₁-C₄, haloalkoxy, methylenedioxy and C₁-C₆, preferably C₁-C₄, alkylsulphonyl.

In another aspect of the invention R⁶ represents a phenyl group optionally substituted by one or more (e.g. one, two, three or four) substituents independently selected from halogen (e.g. fluorine, chlorine, bromine or iodine), amino, nitro, cyano, sulphonyl, sulphonamido, C₁-C₆, preferably C₁-C₄, alkyl, C₁-C₆, preferably C₁-C₄, haloalkoxy and C₁-C₆, preferably C₁-C₄, alkylsulphonyl.

In a further aspect R⁶ is phenyl optionally substituted by halogen or methylenedioxy. In a still further aspect R⁶ is most preferably a phenyl group substituted by halogen. Examples of R⁶ include 3-chlorophenyl, 4-chlorophenyl or, especially, 3,4-dichlorophenyl.

R⁷ and R⁸ each independently represent a hydrogen atom or a group selected from C₁-C₆, preferably C₁-C₄, hydroxyalkyl, C₃-C₆ cycloalkyl (cyclopropyl, cyclobutyl, cyclopentyl or cyclohexyl) and C₁-C₆, preferably C₁-C₄, alkyl optionally substituted by phenyl (e.g. one or two phenyl groups).

Most preferably, R⁷ and R⁸ each independently represent a hydrogen atom, or a group selected from C₂ hydroxyalkyl, cyclopropyl and C₁-C₂ alkyl optionally substituted by phenyl.

Compounds of the invention include all the Examples below, some of which are:

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-methylbenzyl)amine,

N-[4-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino}methyl)phenyl]acetamide,

3-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino}methyl)phenol,

N-[(4-Chloro-1-methyl-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-methyl-2-furyl)methyl]amine,

- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-nitrobenzyl)amine,
 N-Benzyl-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-fluorobenzyl)amine,
 N-(2,6-Dichlorobenzyl)-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 5 N,1-Bis(3,4-dichlorobenzyl)-4-piperidinamine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(2-pyridinylmethyl)amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(3-methyl-2-thienyl)methyl]amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-methyl-2-thienyl)methyl]amine,
 5-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-methoxyphenol,
 10 4-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-nitrophenol,
 3-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-4H-chromen-4-one,
 N-[(5-Chloro-1,3-dimethyl-1H-pyrazol-4-yl)methyl]-1-(3,4-dichlorobenzyl)-4-
 piperidinamine,
 N-[(4-Chloro-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 15 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[[1-(4-methylbenzyl)-1H-pyrazol-5-
 yl]methyl]amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(2-phenyl-1H-imidazol-4-yl)methyl]amine,
 N-[(2-Chloro-3-quinolinyl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(6-methyl-2-pyridinyl)methyl]amine,
 20 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(3-quinolinylmethyl)amine,
 [5-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-furyl]methyl acetate,
 4-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-1,5-dimethyl-2-phenyl-1,2-
 dihydro-3H-pyrazol-3-one,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-pyridinylmethyl)amine,
 25 5-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-nitrophenol,
 N-[2-(tert-Butylsulfanyl)benzyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-ethylbenzyl)amine,
 5-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-hydroxybenzoic acid,
 N-(1,3-Benzodioxol-4-ylmethyl)-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 30 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(1,3-thiazol-2-ylmethyl)amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-ethyl-2-furyl)methyl]amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(2-quinolinylmethyl)amine,

- N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(4-quinolinylmethyl)amine,
 5 5-([1-(3,4-Dichlorobenzyl)-4-piperidiny]amino)methyl)-2-hydroxy-3-methoxybenzoic acid,
 N-[(4-Bromo-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 5 2-[2-([1-(3,4-Dichlorobenzyl)-4-piperidiny]amino)methyl)-6-methoxyphenoxy]acetic acid,
 N-[(4-Bromo-1-methyl-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(4-iodobenzyl)amine,
 3-([1-(3,4-Dichlorobenzyl)-4-piperidiny]amino)methyl)-6,7-dimethyl-4H-chromen-4-
 10 one,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(4-isopropoxybenzyl)amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-[(1-methyl-1H-benzimidazol-2-yl)methyl]amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(3-methylbenzyl)amine,
 15 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(3-pyridinylmethyl)amine,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(2,4-dimethylbenzyl)amine,
 Ethyl 5-([1-(3,4-dichlorobenzyl)-4-piperidiny]amino)methyl)-2-methyl-3-furoate,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-furamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-4-[3-(4-pyridinyl)-1,2,4-oxadiazol-5-yl]butanamide,
 20 2-[[5-(1-Benzyl-2-oxo-1,2-dihydro-3-pyridinyl)-4-methyl-4H-1,2,4-triazol-3-yl]sulfonyl]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]propanamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-6-methoxy-4-quinolinecarboxamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(2-furyl)-4-quinolinecarboxamide,
 25 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-4-(2-methyl-1-oxo-1,2-dihydro-3-isoquinoliny)butanamide,
 3-(1,3-Benzothiazol-2-ylsulfonyl)-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]propanamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(3,5-dimethoxyphenyl)acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(2-methoxyphenyl)acetamide,
 30 2-[5-Chloro-2-oxo-1,3-benzothiazol-3(2H)-yl]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]acetamide,

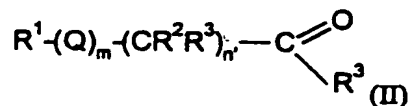
- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[(4,6-dimethyl-2-pyrimidinyl)sulfanyl]acetamide,
 2-(1-Benzothiophen-3-yl)-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-(3,4-dimethoxyphenyl)butanamide,
 5 5-Cyclohexyl-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]pentanamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-fluoro-2-methylbenzamide,
 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(1-phenylethyl)phthalamide,
 2-Cyclopentyl-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide,
 4-Chloro-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-nitrobenzamide,
 10 2,2-Dichloro-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-1-methylcyclopropanecarboxamide,
tert-Butyl 4-[5-({[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino} carbonyl)-2-methoxyphenyl]-1-piperazinecarboxylate,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-5-oxo-1-(2-thienylmethyl)-3-pyrrolidinecarboxamide,
 15 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-[2-oxo-1,3-benzoxazol-3(2H)-yl]propanamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-fluorobenzamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-methylbenzamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-methylbenzamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-(hydroxymethyl)benzamide,
 20 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-{2-[(methylsulfanyl)methyl]-4-pyrimidinyl}-1,2-ethanediamine,
 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[2-(methylsulfanyl)-6-(trifluoromethyl)-4-pyrimidinyl]-1,2-ethanediamine,
 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[5-methoxy-2-(methylsulfanyl)-4-pyrimidinyl]-1,2-ethanediamine,
 25 2-({4-[(2-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino} ethyl)amino]-2-pyrimidinyl) amino)-1-ethanol,
 N⁴-(2-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino} ethyl)-6-methyl-2,4-pyrimidinediamine,
 30 N⁴-(2-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino} ethyl)-N²,6-dimethyl-2,4-pyrimidinediamine,

- 2-Chloro-N⁴-cyclopropyl-N⁶-(2-[[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino]ethyl)-4,6-pyrimidinediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(4-phenyl-2-pyrimidinyl)-1,2-ethanediamine,
- 5 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(trifluoromethyl)-2-pyrimidinyl]-1,2-ethanediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(propylsulfanyl)-2-pyrimidinyl]-1,2-ethanediamine,
- N²-(2-[[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino]ethyl)-N⁴,6-dimethyl-2,4-pyrimidinediamine,
- 10 N⁴-Cyclopropyl-N²-(2-[[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino]ethyl)-2,4-pyrimidinediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(3-pyridinyl)-2-pyrimidinyl]-1,2-ethanediamine,
- 15 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(3-thienyl)-2-pyrimidinyl]-1,2-ethanediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(2-thienyl)-2-pyrimidinyl]-1,2-ethanediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(1-methyl-1H-pyrazolo[3,4-d]pyrimidin-4-yl)-1,2-ethanediamine,
- 20 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(1H-purin-6-yl)-1,2-ethanediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(5-methylthieno[2,3-d]pyrimidin-4-yl)-1,2-ethanediamine,
- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(7-methylthieno[3,2-d]pyrimidin-4-yl)-1,2-ethanediamine,
- 25 N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(9-methyl-9H-purin-6-yl)-1,2-ethanediamine,
- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[[5-(trifluoromethyl)-2-pyridinyl]sulfanyl]acetamide,
- 30 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(5-methyl-1-phenyl-1H-pyrazol-4-yl)acetamide,
- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-5-oxo-5-phenylpentanamide,

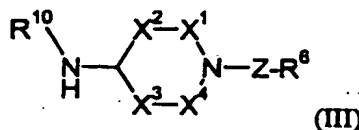
- 2-[2-(4-Chlorophenyl)-5-methyl-1,3-thiazol-4-yl]-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(phenylsulfanyl)acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(4-fluorophenyl)acetamide,
 5 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[2-(2-pyrazinyl)-1,3-thiazol-4-yl]acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[(5-phenyl-2-pyrimidinyl)sulfanyl]acetamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-1H-benzimidazol-2-amine,
 10 2-[[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino]-N-(3-methoxyphenyl)acetamide, dihydrochloride salt,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N'-(3,4-dichlorophenyl)urea,
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N'-(3-methoxyphenyl)urea, and
 N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-methoxybenzyl)amine, dihydrochloride
 15 salt.

The present invention further provides a process for the preparation of a compound of formula (I) or (Ia) which comprises:

- (a) when n is at least 1, the CR²R³ group attached directly to T is CHR³ and T is NR¹⁰,
 20 reacting a compound of formula

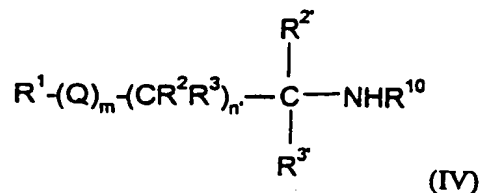


wherein n' is 0 or an integer from 1 to 3 and R¹, R², R³, m and Q are as defined above, with a compound of formula

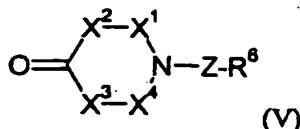


- 25 or a salt thereof, wherein X¹, X², X³, X⁴, Z, R⁶ and R¹⁰ are as defined above, in the presence of a reducing agent; or

(b) when n is at least 1, the CR²R³ group attached directly to T is C(C₁-C₄ alkyl)₂ and T is NR¹⁰, reacting a compound of formula



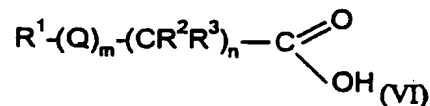
wherein n' is 0 or an integer from 1 to 3, R² and R³ each independently represent a C₁-C₄ alkyl group, and R¹, R², R³, R¹⁰, m and Q are as defined above, with a compound of formula



wherein X¹, X², X³, X⁴, Z and R⁶ are as defined above, in the presence of a reducing agent; or

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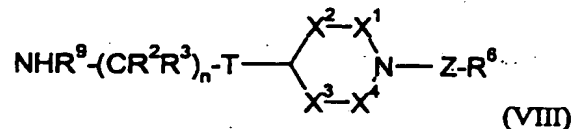
(c) when T is C(O)NR¹⁰, reacting a compound of formula



wherein R¹, R², R³, Q, m and n are as defined above, with a compound of formula (III) or a salt thereof as defined in (a) above; or

15

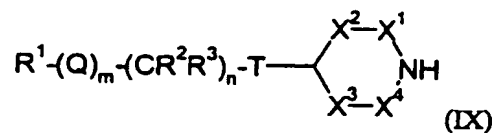
(d) when m is 1 and Q is NR⁹, reacting a compound of formula (VII), R¹ - L¹, wherein L¹ represents a leaving group (e.g. a halogen atom) and R¹ is as defined above, with a compound of formula



or a salt thereof, wherein n, T, X¹, X², X³, X⁴, Z, R², R³, R⁶ and R⁹ are as defined above; or

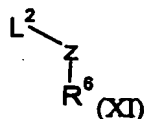
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(e) when at least one of R^4 and R^5 represents a hydrogen atom, reacting a compound of formula



or a salt thereof, wherein R^1 , R^2 , R^3 , Q , m , n , X^1 , X^2 , X^3 , X^4 and T are as defined above, with a compound of general formula (X), $R^6-C(O)-R^{20}$, wherein R^{20} represents a hydrogen atom or a C_1-C_4 alkyl group and R^6 is as defined above, in the presence of a reducing agent; or

(f) reacting a compound of formula (IX) as defined in (e) above, with a compound of formula



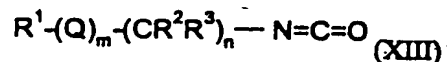
wherein L^2 represents a leaving group (e.g. a halogen atom) and Z and R^6 are as defined above; or

(g) when T is NR^{10} , reacting a compound of formula



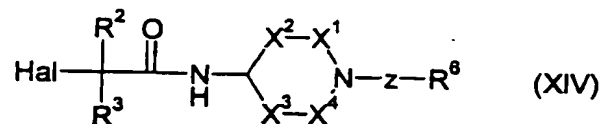
wherein L^3 represents a leaving group (e.g. a halogen atom) and R^1 , R^2 , R^3 , m , n and Q are as defined above, with a compound of formula (III) or a salt thereof as defined in (a) above; or

(h) when T is $NHC(O)NR^{10}$, reacting a compound of formula



wherein R^1 , R^2 , R^3 , Q , m and n are as defined above, with a compound of formula (III) or a salt thereof as defined in (a) above; or

(i) when T is $C(O)NH$, Z is CH_2 , n is 1, R^2 and R^3 are hydrogen or C_1-C_4 alkyl and Q is oxygen or sulphur, reacting a compound of formula (XIV):



wherein Hal is a suitable halogen (such as bromo or chloro), $\text{R}^2, \text{R}^3, \text{X}^1, \text{X}^2, \text{X}^3, \text{X}^4, \text{Z}$ and R^6 are as defined above, with R^1OH or R^1SH in the presence of a suitable base (such as potassium carbonate or sodium or potassium hydroxide);

and optionally after (a), (b), (c), (d), (e), (f), (g), (h) or (i) forming a pharmaceutically acceptable salt or solvate of the compound of formula (I) or (Ia) obtained.

Compounds of formulae (II) to (XIV) are either commercially available, or are known in the literature or may be prepared using known techniques.

It will be appreciated by those skilled in the art that in the processes of the present invention certain functional groups such as hydroxyl or amino groups in the starting reagents or intermediate compounds may need to be protected by protecting groups. Thus, the preparation of the compounds of formula (I) or (Ia) may involve, at an appropriate stage, the addition and subsequent removal of one or more protecting groups.

The protection and deprotection of functional groups is described in 'Protective Groups in Organic Chemistry', edited by J.W.F. McOmie, Plenum Press (1973) and 'Protective Groups in Organic Synthesis', 2nd edition, T.W. Greene and P.G.M. Wuts, Wiley-Interscience (1991).

The compounds of the invention and intermediates may be isolated from their reaction mixtures, and if necessary further purified, by using standard techniques.

The compounds of formula (I) and (Ia) have activity as pharmaceuticals, in particular as modulators of chemokine receptor activity. More particularly, the compounds have utility as modulators of the activity of chemokine receptors CCR1 and/or CCR3.

A further aspect of the invention involves the use of a compound of formula (I) or (Ia) in the treatment of conditions or diseases in which modulation of chemokine receptor activity is beneficial.

5 Thus, compounds of formula (I) or (Ia) may be used in the treatment of autoimmune, inflammatory, proliferative and hyperproliferative diseases and immunologically-mediated diseases including rejection of transplanted organs or tissues and Acquired Immunodeficiency Syndrome (AIDS). Examples of these conditions include:

10 (1) (the respiratory tract) obstructive airways diseases including chronic obstructive pulmonary disease (COPD); asthma, such as bronchial, allergic, intrinsic, extrinsic and dust asthma, particularly chronic or inveterate asthma (e.g. late asthma and airways hyper-responsiveness); bronchitis; acute, allergic, atrophic rhinitis and chronic rhinitis including rhinitis caseosa, hypertrophic rhinitis, rhinitis purulenta, rhinitis sicca and rhinitis
15 medicamentosa; membranous rhinitis including croupous, fibrinous and pseudomembranous rhinitis and scrofulous rhinitis; seasonal rhinitis including rhinitis nervosa (hay fever) and vasomotor rhinitis; sarcoidosis, farmer's lung and related diseases, fibroid lung and idiopathic interstitial pneumonia;

20 (2) (bone and joints) rheumatoid arthritis, osteoarthritis, seronegative spondyloarthropathies (including ankylosing spondylitis, psoriatic arthritis and Reiter's disease), Behcet's disease, Sjogren's syndrome and systemic sclerosis;

25 (3) (skin) psoriasis, atopic dermatitis, contact dermatitis and other eczematous dermatides, seborrhoetic dermatitis, Lichen planus, Pemphigus, bullous Pemphigus, Epidermolysis bullosa, urticaria, angiodermas, vasculitides, erythemas, cutaneous eosinophilias, uveitis, Alopecia areata and vernal conjunctivitis;

30 (4) (gastrointestinal tract) Coeliac disease, proctitis, eosinophilic gastro-enteritis, mastocytosis, Crohn's disease, inflammatory bowel disease, irritable bowel syndrome, ulcerative colitis, food-related allergies which have effects remote from the gut, e.g., migraine, rhinitis and eczema;

(5) (other tissues and systemic disease) multiple sclerosis, atherosclerosis, Acquired Immunodeficiency Syndrome (AIDS), lupus erythematosus, systemic lupus, erythematosus, Hashimoto's thyroiditis, myasthenia gravis, type I diabetes, nephrotic syndrome, eosinophilia fasciitis, hyper IgE syndrome, lepromatous leprosy, sezary syndrome and idiopathic thrombocytopenia pupura; and

(6) (allograft rejection) acute and chronic following, for example, transplantation of kidney, heart, liver, lung, bone marrow, skin and cornea; and chronic graft versus host disease.

Thus, the present invention provides a compound of formula (I) or (Ia), or a pharmaceutically acceptable salt thereof, a solvate thereof or a solvate of a salt thereof, as hereinbefore defined for use in therapy.

In a further aspect, the present invention provides the use of a compound of formula (I) or (Ia), or a pharmaceutically acceptable salt thereof, a solvate thereof or a solvate of a salt thereof, as hereinbefore defined in the manufacture of a medicament for use in therapy.

In the context of the present specification, the term "therapy" also includes "prophylaxis" unless there are specific indications to the contrary. The terms "therapeutic" and "therapeutically" should be construed accordingly.

Prophylaxis is expected to be particularly relevant to the treatment of persons who have suffered a previous episode of, or are otherwise considered to be at increased risk of, the disease or condition in question. Persons at risk of developing a particular disease or condition generally include those having a family history of the disease or condition, or those who have been identified by genetic testing or screening to be particularly susceptible to developing the disease or condition.

In another aspect the present invention provides the use of a compound of formula (I), wherein Z is CR^4R^5 , $C(O)$ or $CR^4R^5-Z^1$; Z^1 is C_{1-4} alkylene, C_{2-4} alkenylene or $C(O)NH$; R^1

represents a C₁-C₁₂ alkyl group optionally substituted by one or more substituents independently selected from cyano, hydroxyl, C₁-C₆ alkoxy, C₁-C₆ alkylthio, C₃₋₇ cycloalkyl, C₁-C₆ alkoxycarbonyl and phenyl (itself optionally substituted by one or more of halogen, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxycarbonyl); or R¹ represents C₂-C₆ alkenyl optionally substituted by phenyl (itself optionally substituted by one or more of halogen, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxycarbonyl); or R¹ represents a 3- to 14-membered saturated or unsaturated ring system which optionally comprises up to two ring carbon atoms that form carbonyl groups and which optionally further comprises up to 4 ring heteroatoms independently selected from nitrogen, oxygen and sulphur, wherein the ring system is optionally substituted by one or more substituents independently selected from: halogen, cyano, nitro, oxo, hydroxyl, C₁-C₆ alkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ haloalkyl, C₁₋₆ alkoxy(C₁-C₆ alkyl), C₃₋₇ cycloalkyl(C₁-C₆ alkyl), C₁-C₆ alkylthio(C₁-C₆ alkyl), C₁-C₆ alkylcarbonyloxy(C₁-C₆ alkyl), C₁-C₆ alkylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl), heterocyclyl(C₁-C₆ alkyl), arylS(O)₂(C₁-C₆ alkyl), heterocyclylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl)S(O)₂, heterocyclyl(C₁-C₆ alkyl)S(O)₂, C₂-C₆ alkenyl, C₁-C₆ alkoxy, carboxy-substituted C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ hydroxyalkoxy, C₁-C₆ alkylcarboxy-substituted C₁-C₆ alkoxy, aryloxy, heterocyclioxy, C₁-C₆ alkylthio, C₃₋₇ cycloalkyl(C₁-C₆ alkylthio), C₃₋₆ alkynylthio, C₁-C₆ alkylcarbonylamino, C₁-C₆ haloalkylcarbonylamino, SO₃H, -NR⁷R⁸, -C(O)NR²³R²⁴, S(O)₂NR¹⁸R¹⁹, S(O)₂R²⁰, R²⁵C(O), carboxyl, C₁-C₆ alkoxycarbonyl, aryl and heterocyclyl; wherein the foregoing aryl and heterocyclyl moieties are optionally substituted by one or more of halogen, oxo, hydroxy, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxycarbonyl; m is 0 or 1; Q represents an oxygen or sulphur atom or a group NR⁹, C(O), C(O)NR⁹, NR⁹C(O) or CH=CH; n is 0, 1, 2, 3, 4, 5 or 6 provided that when n is 0, then m is 0; each R² and R³ independently represents a hydrogen atom or a C₁-C₄ alkyl group, or (CR²R³)_n represents C₃-C₇ cycloalkyl optionally substituted by C₁-C₄ alkyl; T represents a group NR¹⁰, C(O)NR¹⁰, NR¹¹C(O)NR¹⁰ or C(O)NR¹⁰NR¹¹; X¹, X², X³ and X⁴ are, independently, CH₂, CHR¹² {wherein each R¹² is, independently, C₁-C₄ alkyl or C₃-C₇ cycloalkyl(C₁-C₄ alkyl)} or C=O; or, when they are

CHR¹², the R¹² groups of X¹ and X³ or X⁴, or, X² and X³ or X⁴ join to form a two or three atom chain which is CH₂CH₂, CH₂CH₂CH₂, CH₂OCH₂ or CH₂SCH₂; provided always that at least two of X¹, X², X³ and X⁴ are CH₂; R⁴ and R⁵ each independently represent a hydrogen atom or a C₁-C₄ alkyl group; R⁶ is aryl or heterocyclyl, both optionally substituted by one or more of: halogen, cyano, nitro, oxo, hydroxyl, C₁-C₈ alkyl, C₁-C₆ hydroxyalkyl, C₁-C₆ haloalkyl, C₁₋₆ alkoxy(C₁-C₆ alkyl), C₃-C₇ cycloalkyl(C₁-C₆ alkyl), C₁-C₆ alkylthio(C₁-C₆ alkyl), C₁-C₆ alkylcarbonyloxy(C₁-C₆ alkyl), C₁-C₆ alkylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl), heterocyclyl(C₁-C₆ alkyl), arylS(O)₂(C₁-C₆ alkyl), heterocyclylS(O)₂(C₁-C₆ alkyl), aryl(C₁-C₆ alkyl)S(O)₂, heterocyclyl(C₁-C₆ alkyl)S(O)₂, C₂-C₆ alkenyl, C₁-C₆ alkoxy, carboxy-substituted C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, C₁-C₆ hydroxyalkoxy, C₁-C₆ alkylcarboxy-substituted C₁-C₆ alkoxy, aryloxy, heterocyclyloxy, C₁-C₆ alkylthio, C₃-C₇ cycloalkyl(C₁-C₆ alkylthio), C₃-C₆ alkynylthio, C₁-C₆ alkylcarbonylamino, C₁-C₆ haloalkylcarbonylamino, SO₃H, -NR¹⁶R¹⁷, -C(O)NR²¹R²², S(O)₂NR¹³R¹⁴, S(O)₂R¹⁵, R²⁶C(O), carboxyl, C₁-C₆ alkoxy-carbonyl, aryl and heterocyclyl; wherein the foregoing aryl and heterocyclyl moieties are optionally substituted by one or more of halogen, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxy-carbonyl; R⁷, R⁸, R⁹, R¹⁰, R¹¹, R¹³, R¹⁴, R¹⁶, R¹⁷, R¹⁸, R¹⁹, R²¹, R²², R²³ and R²⁴ are, independently hydrogen, C₁-C₆ alkyl, C₁-C₆ haloalkyl, C₁-C₆ hydroxyalkyl, C₃-C₇ cycloalkyl, C₃-C₇ cycloalkyl(C₁-C₄ alkyl) or phenyl(C₁-C₆ alkyl); R¹⁵ and R²⁰ are, independently, C₁-C₆ alkyl, C₁-C₆ hydroxyalkyl, C₃-C₆ cycloalkyl, C₃-C₇ cycloalkyl(C₁-C₄ alkyl) or C₁-C₆ alkyl optionally substituted by phenyl; and, R²⁵ and R²⁶ are, independently, C₁-C₆ alkyl or phenyl (optionally substituted by one or more of halogen, nitro, cyano, C₁-C₆ alkyl, C₁-C₆ haloalkyl, phenyl(C₁-C₆ alkyl), C₁-C₆ alkoxy, C₁-C₆ haloalkoxy, S(O)₂(C₁-C₆ alkyl), C(O)NH₂, carboxy or C₁-C₆ alkoxy-carbonyl); or a pharmaceutically acceptable salt thereof, or solvate thereof, or a solvate of a salt thereof, in the manufacture of a medicament for the modulation of a chemokine receptor (such as CCR1 or CCR3). In a further aspect such medicament is for the treatment of asthma.

The invention also provides a method of treating an inflammatory disease in a person suffering from, or at risk of, said disease, which comprises administering to the person a therapeutically effective amount of a compound of formula (I) or (Ia), or a

pharmaceutically acceptable salt thereof, a solvate thereof or a solvate of a salt thereof, as hereinbefore defined.

For the above-mentioned therapeutic uses the dosage administered will, of course, vary with the compound employed, the mode of administration, the treatment desired and the disorder indicated.

A compound of formula (I) or (Ia) or a pharmaceutically acceptable salt, solvate or solvate of a salt, may be used on its own but will generally be administered in the form of a pharmaceutical composition in which the formula (I) or (Ia) compound, salt, solvate or solvate of salt (active ingredient) is in association with a pharmaceutically acceptable adjuvant, diluent or carrier. Depending on the mode of administration, the pharmaceutical composition will preferably comprise from 0.05 to 99 %w (per cent by weight), more preferably from 0.05 to 80 %w, still more preferably from 0.10 to 70 %w, and even more preferably from 0.10 to 50 %w, of active ingredient, all percentages by weight being based on total composition.

The present invention also provides a pharmaceutical composition comprising a compound of formula (I) or (Ia), or a pharmaceutically acceptable salt, solvate or solvate of salt thereof, as hereinbefore defined, in association with a pharmaceutically acceptable adjuvant, diluent or carrier.

The invention further provides a process for the preparation of a pharmaceutical composition of the invention which comprises mixing a compound of formula (I) or (Ia), or a pharmaceutically acceptable salt, solvate or solvate of salt thereof, as hereinbefore defined, with a pharmaceutically acceptable adjuvant, diluent or carrier.

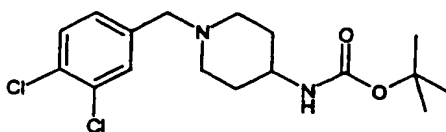
The pharmaceutical compositions may be administered topically (e.g. to the lung and/or airways or to the skin) in the form of solutions, suspensions, heptafluoroalkane aerosols and dry powder formulations; or systemically, e.g. by oral administration in the form of tablets, capsules, syrups, powders, aerosols or granules, or by parenteral administration in

the form of solutions or suspensions, or by subcutaneous administration or by rectal administration in the form of suppositories or transdermally.

The present invention will be further explained by reference to the following illustrative examples.

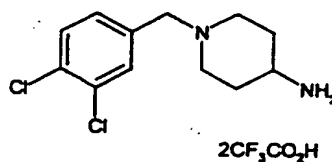
Examples 1-47

(i) tert-Butyl 1-(3,4-dichlorobenzyl)-4-piperidinylcarbamate



10 Sodium triacetoxyborohydride (6g) was added to a stirred solution of 3,4-dichlorobenzaldehyde (4.2g) and 1,1-dimethylethyl-4-piperidinyl carbamate (4g) in dichloromethane (50ml). The mixture was stirred at room temperature for 4h then partitioned between ethyl acetate and aqueous sodium hydrogencarbonate. The organic layer was washed with water, dried and evaporated under reduced pressure. The residue
15 was triturated with ether to give a white solid (3.5g). Used directly.

(ii) 1-(3,4-Dichlorobenzyl)-4-piperidinamine, di-trifluoroacetate salt



The product from step (i) (3.5g) was treated with trifluoroacetic acid (10ml) in
20 dichloromethane (40ml). After 72h, the solution was evaporated, the residue triturated with ether and the solid (4.3g) collected.

MS: APCI(+ve) 259/61 (M+1)

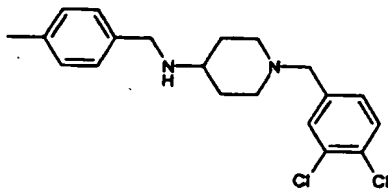
25 (iii) Examples 1-47

The product from step (ii) (2mg), the appropriate aldehyde (2 equivalents), sodium triacetoxyborohydride (3 equivalents) and diisopropylethylamine (2 equivalents) in

acetonitrile (0.08ml) and 1-methyl-2-pyrrolidinone (0.12ml) was left at room temperature for 24h. The reaction mixture was evaporated to dryness and the residue dissolved in dimethylsulphoxide (0.4ml).

5 **Example 1**

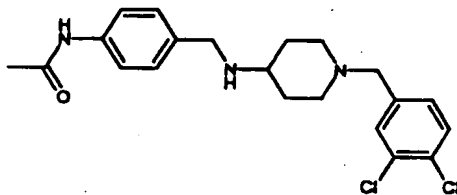
N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(4-methylbenzyl)amine



MS: APCI(+ve) 363 (M+1)

10 **Example 2**

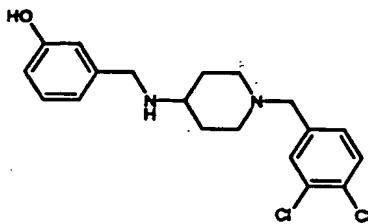
N-[4-({[1-(3,4-Dichlorobenzyl)-4-piperidiny]amino}methyl)phenyl]acetamide



MS: APCI(+ve) 406 (M+1)

15 **Example 3**

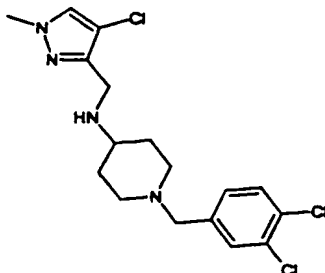
3-({[1-(3,4-Dichlorobenzyl)-4-piperidiny]amino}methyl)phenol



MS: APCI(+ve) 365 (M+1)

20 **Example 4**

N-[(4-Chloro-1-methyl-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine

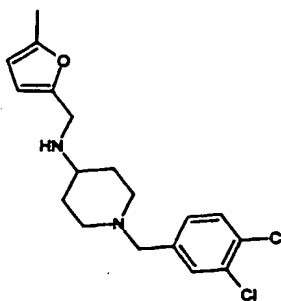


MS: APCI(+ve) 389 (M+1)

5

Example 5

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-methyl-2-furyl)methyl]amine

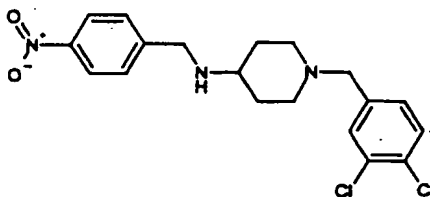


MS: APCI(+ve) 353 (M+1)

10

Example 6

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-nitrobenzyl)amine

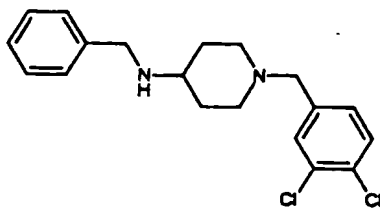


MS: APCI(+ve) 394 (M+1)

15

Example 7

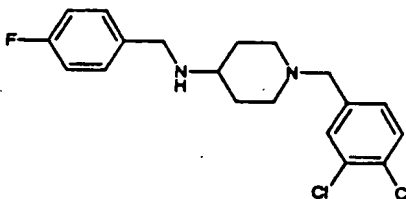
N-Benzyl-1-(3,4-dichlorobenzyl)-4-piperidinamine



MS: APCI(+ve) 349 (M+1)

Example 8

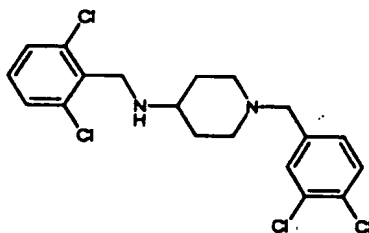
- 5 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-fluorobenzyl)amine**



MS: APCI(+ve) 367 (M+1)

Example 9

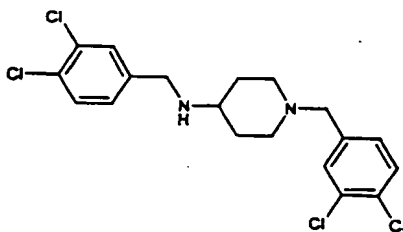
- 10 **N-(2,6-Dichlorobenzyl)-1-(3,4-dichlorobenzyl)-4-piperidinamine**



MS: APCI(+ve) 419 (M+1)

Example 10

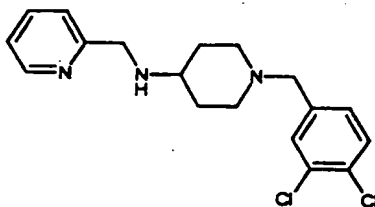
- 15 **N,1-Bis(3,4-dichlorobenzyl)-4-piperidinamine**



MS: APCI(+ve) 419 (M+1)

5 **Example 11**

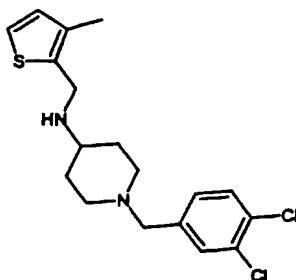
N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(2-pyridinylmethyl)amine



MS: APCI(+ve) 350 (M+1)

10 **Example 12**

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(3-methyl-2-thienyl)methyl]amine



MS: APCI(+ve) 369 (M+1)

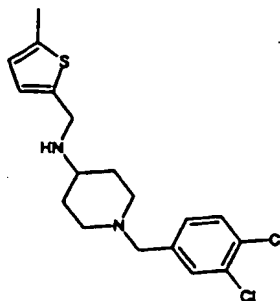
15 **Example 13**

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-methyl-2-thienyl)methyl]amine

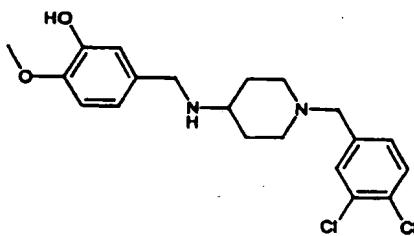
WO 01/14333

PCT/GB00/03179

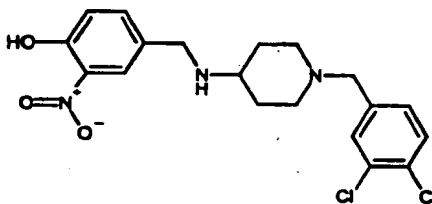
31



MS: APCI(+ve) 369 (M+1)

Example 145 **5-(((1-(3,4-Dichlorobenzyl)-4-piperidinyl)amino)methyl)-2-methoxyphenol**

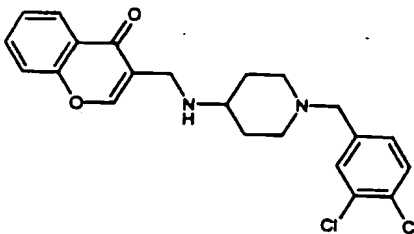
MS: APCI(+ve) 395 (M+1)

Example 1510 **4-(((1-(3,4-Dichlorobenzyl)-4-piperidinyl)amino)methyl)-2-nitrophenol**

MS: APCI(+ve) 410 (M+1)

Example 1615 **3-(((1-(3,4-Dichlorobenzyl)-4-piperidinyl)amino)methyl)-4H-chromen-4-one**

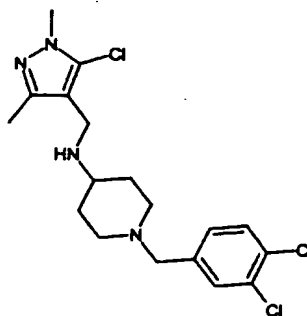
32



MS: APCI(+ve) 417 (M+1)

Example 17

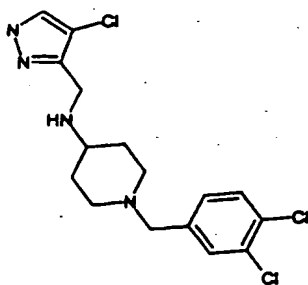
5 **N-[(5-Chloro-1,3-dimethyl-1H-pyrazol-4-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine**



MS: APCI(+ve) 403 (M+1)

10 **Example 18**

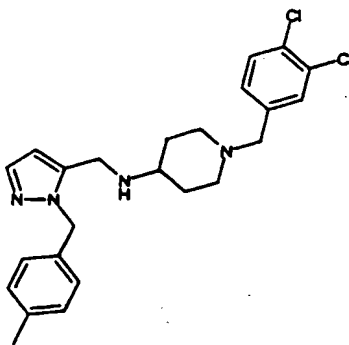
N-[(4-Chloro-1H-pyrazol-3-yl)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine



MS: APCI(+ve) 373 (M+1)

Example 19

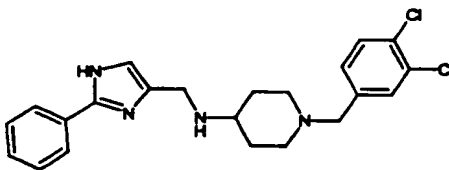
N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-([1-(4-methylbenzyl)-1H-pyrazol-5-yl]methyl)amine



5 MS: APCI(+ve) 443 (M+1)

Example 20

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-([2-phenyl-1H-imidazol-4-yl]methyl)amine

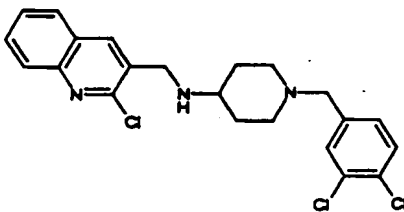


10

MS: APCI(+ve) 414 (M+1)

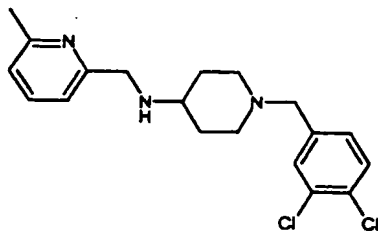
Example 21

N-[(2-Chloro-3-quinoliny)methyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine



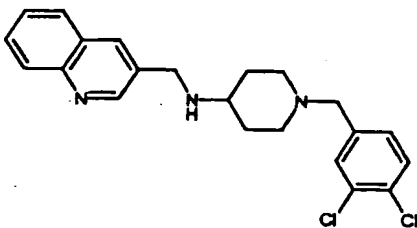
15

MS: APCI(+ve) 434 (M+1)

Example 22**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(6-methyl-2-pyridinyl)methyl]amine**

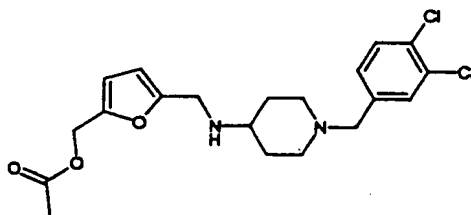
MS: APCI(+ve) 364 (M+1)

5

Example 23**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(3-quinolinylmethyl)amine**

MS: APCI(+ve) 400 (M+1)

10

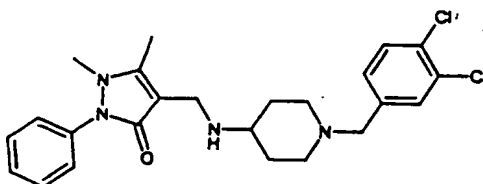
Example 24**[5-({[1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino}methyl)-2-furyl]methyl acetate**

MS: APCI(+ve) 411 (M+1)

15

Example 25

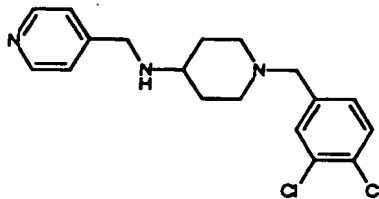
4-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-1,5-dimethyl-2-phenyl-1,2-dihydro-3H-pyrazol-3-one



5 MS: APCI(+ve) 459 (M+1)

Example 26

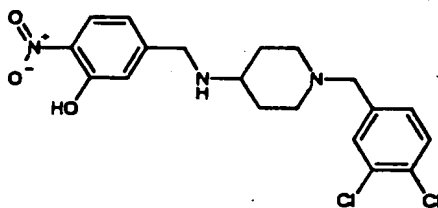
N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-pyridinylmethyl)amine



10 MS: APCI(+ve) 350 (M+1)

Example 27

5-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-nitrophenol



15 MS: APCI(+ve) 410 (M+1)

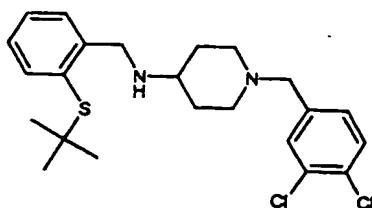
Example 28

N-[2-(tert-Butylsulfanyl)benzyl]-1-(3,4-dichlorobenzyl)-4-piperidinamine

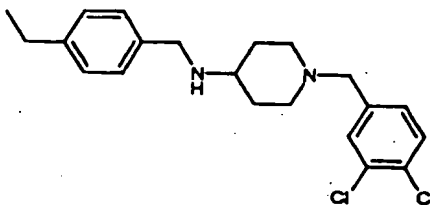
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PCT/GB00/03179

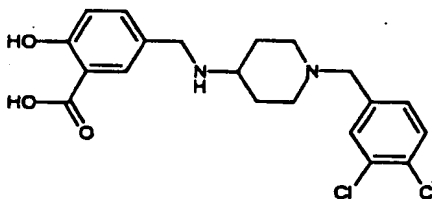
36



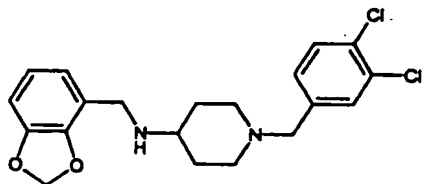
MS: APCI(+ve) 437 (M+1)

Example 295 **N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N-(4-ethylbenzyl)amine**

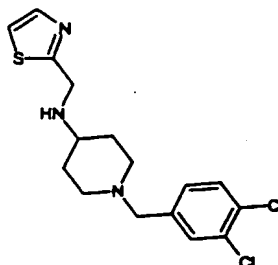
MS: APCI(+ve) 377 (M+1)

Example 3010 **5-(((1-(3,4-Dichlorobenzyl)-4-piperidiny]amino)methyl)-2-hydroxybenzoic acid**

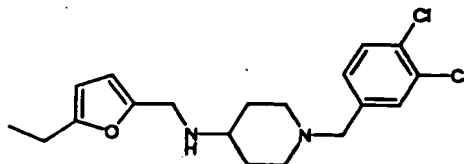
MS: APCI(+ve) 409 (M+1)

Example 3115 **N-(1,3-Benzodioxol-4-ylmethyl)-1-(3,4-dichlorobenzyl)-4-piperidinamine**

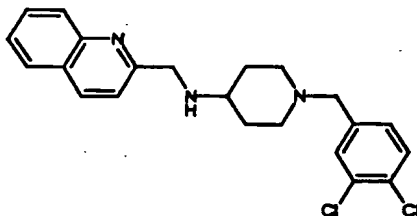
MS: APCI(+ve) 393 (M+1)

Example 32**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(1,3-thiazol-2-ylmethyl)amine**

5 MS: APCI(+ve) 356 (M+1)

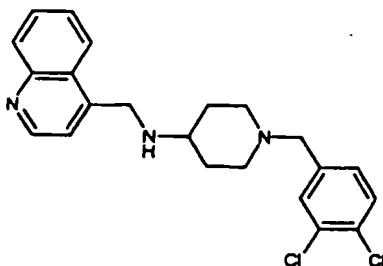
Example 33**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(5-ethyl-2-furyl)methyl]amine**

10 MS: APCI(+ve) 367 (M+1)

Example 34**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(2-quinolinylmethyl)amine**

15 MS: APCI(+ve) 400 (M+1)

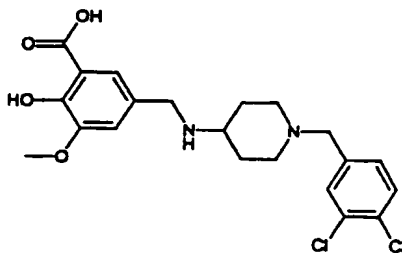
Example 35**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-quinolinylmethyl)amine**



MS: APCI(+ve) 400 (M+1)

Example 36

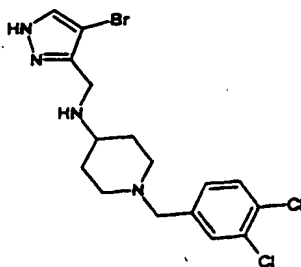
5 **5-(((1-(3,4-Dichlorobenzyl)-4-piperidinyl)amino)methyl)-2-hydroxy-3-methoxybenzoic acid**



MS: APCI(+ve) 439 (M+1)

10 **Example 37**

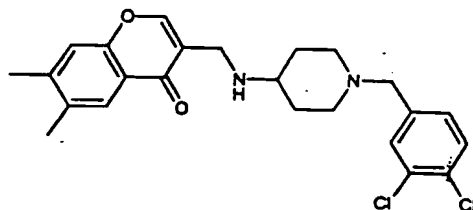
N-((4-Bromo-1H-pyrazol-3-yl)methyl)-1-(3,4-dichlorobenzyl)-4-piperidinamine



MS: APCI(+ve) 419 (M+1)

15 **Example 38**

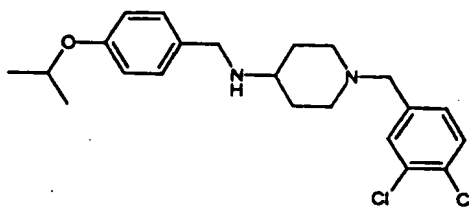
40



MS: APCI(+ve) 445 (M+1)

Example 42

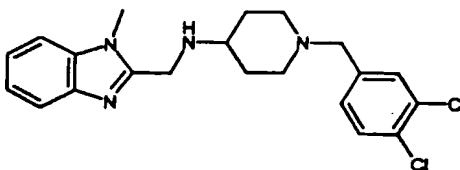
- 5 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-isopropoxybenzyl)amine**



MS: APCI(+ve) 407 (M+1)

Example 43

- 10 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-[(1-methyl-1H-benzimidazol-2-yl)methyl]amine**



MS: APCI(+ve) 403 (M+1)

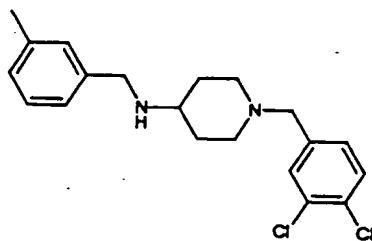
15 **Example 44**

- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(3-methylbenzyl)amine**

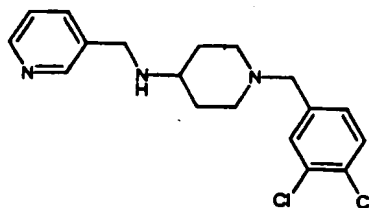
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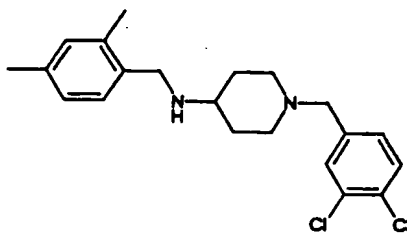
41



MS: APCI(+ve) 363 (M+1)

Example 455 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(3-pyridinylmethyl)amine**

MS: APCI(+ve) 350 (M+1)

Example 4610 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(2,4-dimethylbenzyl)amine**

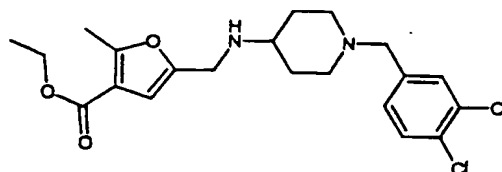
MS: APCI(+ve) 377 (M+1)

Example 4715 **Ethyl 5-([1-(3,4-dichlorobenzyl)-4-piperidinyl]amino)methyl)-2-methyl-3-furoate**

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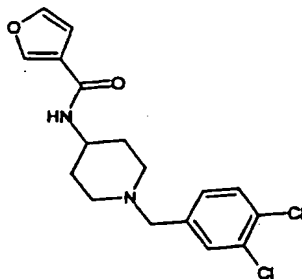
42



MS: APCI(+ve) 425 (M+1)

Examples 48-73**(i) Examples 48-73**

Bromo-tris-pyrrolidino-phosphonium hexafluorophosphate (2 equiv) was added to a solution of the product from Example 1 step (ii) (hydrochloride salt) (1mg), the appropriate acid (2 equivalents) and diisopropylethylamine (5 equivalents) in dimethylformamide (0.17ml) and was left at room temperature for 24h. The reaction mixture was evaporated to dryness and the residue dissolved in dimethylsulphoxide (0.3ml).

Example 48**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-furamide**

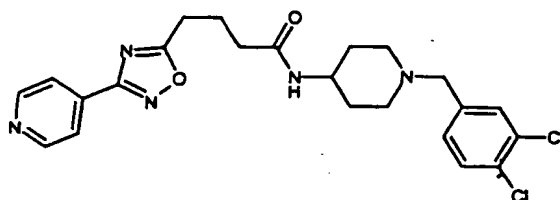
MS: APCI(+ve) 353 (M+1)

Example 49**N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-[3-(4-pyridinyl)-1,2,4-oxadiazol-5-yl]butanamide**

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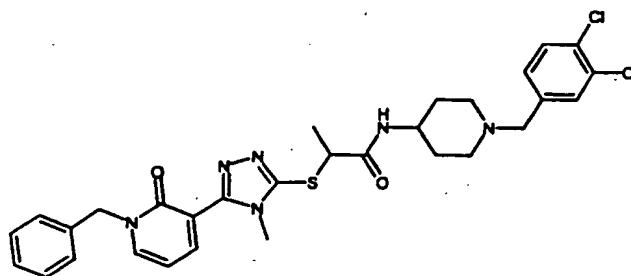
43



MS: APCI(+ve) 474 (M+1)

Example 50

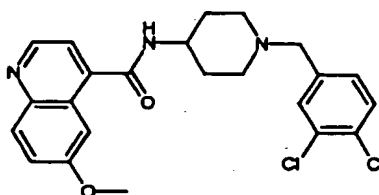
- 3 **2-([5-(1-Benzyl-2-oxo-1,2-dihydro-3-pyridinyl)-4-methyl-4H-1,2,4-triazol-3-yl]sulfanyl)-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]propanamide**



MS: APCI(+ve) 611 (M+1)

10 **Example 51**

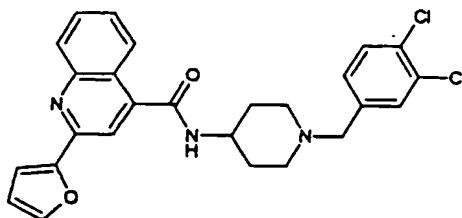
- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-6-methoxy-4-quinolinecarboxamide**



MS: APCI(+ve) 444 (M+1)

15 **Example 52**

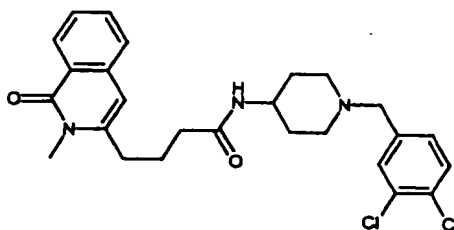
- N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(2-furyl)-4-quinolinecarboxamide**



MS: APCI(+ve) 480 (M+1)

Example 53

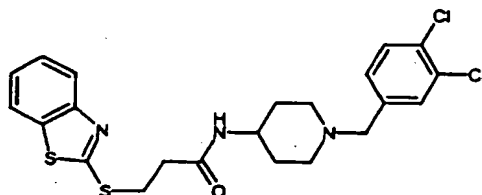
- 5 **N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-4-(2-methyl-1-oxo-1,2-dihydro-3-isoquinoliny)butanamide**



MS: APCI(+ve) 486 (M+1)

10 Example 54

- 3-(1,3-Benzothiazol-2-ylsulfany)-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]propanamide**



MS: APCI(+ve) 480 (M+1)

15

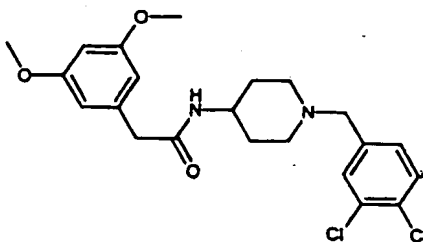
Example 55

- N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(3,5-dimethoxyphenyl)acetamide**

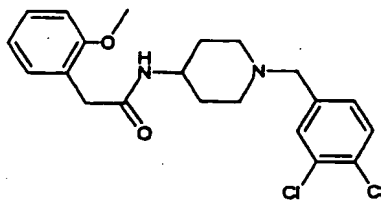
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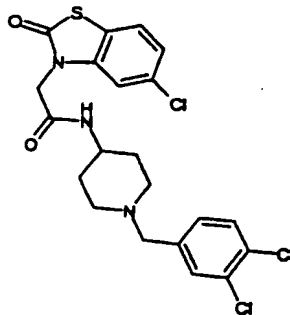
45



MS: APCI(+ve) 437 (M+1)

Example 565 **N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(2-methoxyphenyl)acetamide**

MS: APCI(+ve) 407 (M+1)

Example 5710 **2-[5-Chloro-2-oxo-1,3-benzothiazol-3(2H)-yl]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]acetamide**

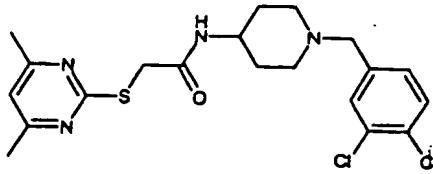
MS: APCI(+ve) 486 (M+1)

15 **Example 58****N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-[(4,6-dimethyl-2-pyrimidinyl)sulfanyl]acetamide**

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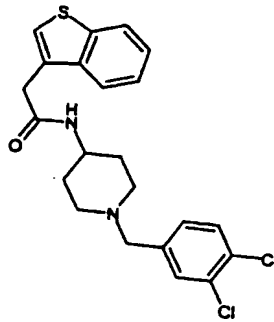
46



MS: APCI(+ve) 439 (M+1)

Example 59

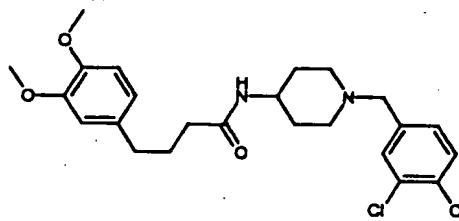
5 **2-(1-Benzothiophen-3-yl)-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide**



MS: APCI(+ve) 433 (M+1)

Example 60

10 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-(3,4-dimethoxyphenyl)butanamide**



MS: APCI(+ve) 465 (M+1)

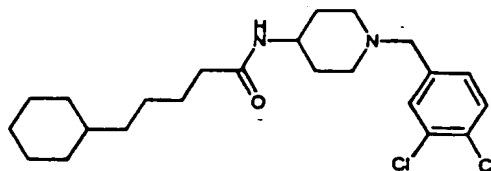
Example 61

15 **5-Cyclohexyl-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]pentanamide**

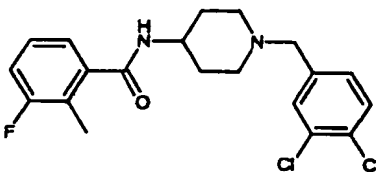
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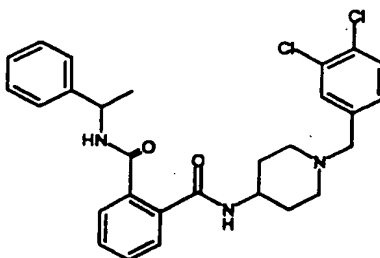
47



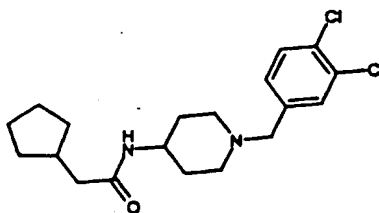
MS: APCI(+ve) 425 (M+1)

Example 625 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-fluoro-2-methylbenzamide**

MS: APCI(+ve) 395 (M+1)

Example 6310 **N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(1-phenylethyl)phthalamide**

MS: APCI(+ve) 510 (M+1)

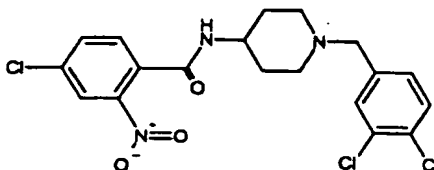
Example 6415 **2-Cyclopentyl-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide**

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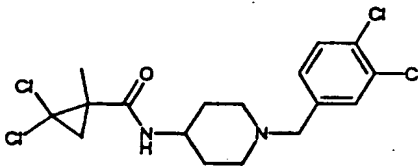
PCT/GB00/03179

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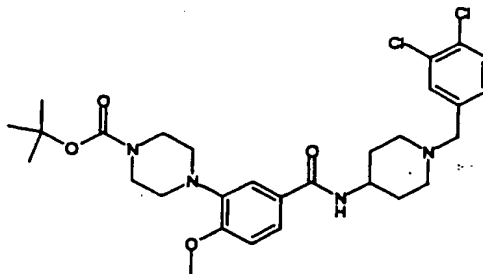
MS: APCI(+ve) 369 (M+1)

Example 65**4-Chloro-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-nitrobenzamide**

MS: APCI(+ve) 444 (M+1)

Example 66**2,2-Dichloro-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-1-methylcyclopropanecarboxamide**

MS: APCI(+ve) 411 (M+1)

Example 67**tert-Butyl 4-[5-({[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino}carbonyl)-2-methoxyphenyl]-1-piperazinecarboxylate**

MS: APCI(+ve) 577 (M+1)

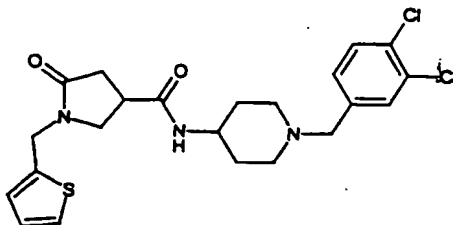
Example 68

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N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-5-oxo-1-(2-thienylmethyl)-3-pyrrolidinecarboxamide

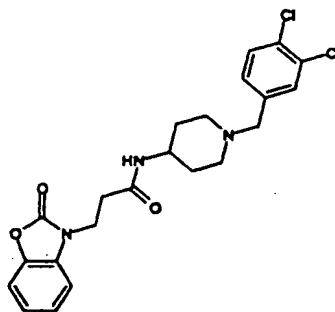


MS: APCI(+ve) 466 (M+1)

5

Example 69

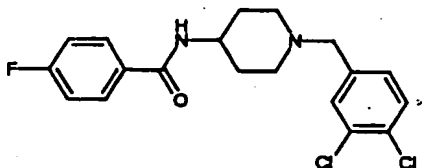
N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-[2-oxo-1,3-benzoxazol-3(2H)-yl]propanamide



10 MS: APCI(+ve) 448 (M+1)

Example 70

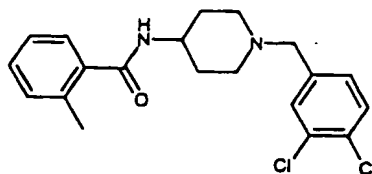
N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-fluorobenzamide



15 MS: APCI(+ve) 381 (M+1)

Example 71

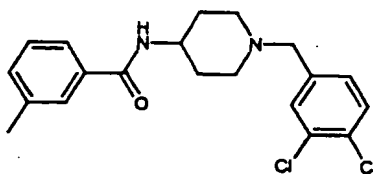
N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-methylbenzamide



MS: APCI(+ve) 377 (M+1)

Example 72

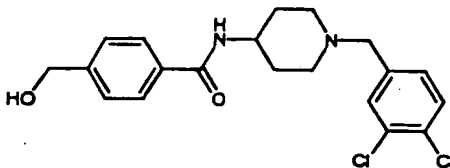
- 5 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-methylbenzamide**



MS: APCI(+ve) 377 (M+1)

Example 73

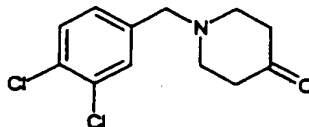
- 10 **N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-4-(hydroxymethyl)benzamide**



MS: APCI(+ve) 393 (M+1)

Examples 74-93

- 15 **(i) 1-(3,4-Dichlorobenzyl)-4-piperidinone**

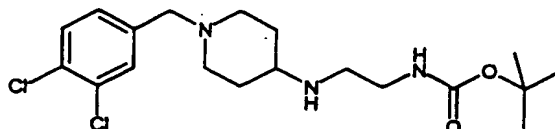


A solution of 3,4-dichlorobenzyl chloride (2.8ml), 4-ketopiperidine hydrochloride monohydrate and triethylamine (8ml) in dimethylformamide (30ml) was stirred at room temperature for 20h. The mixture was partitioned between water and ethyl acetate, the

organic layer dried and evaporated under reduced pressure. Purification was by chromatography eluting with 40-50% ethyl acetate/isohexane. Yield 2.1g.

MS: APCI(+ve) 258/60 (M+1)

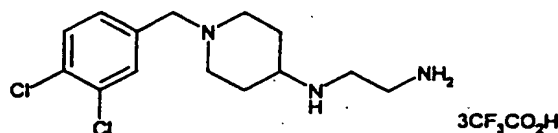
5 (ii) **tert-Butyl 2-[[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino]ethylcarbamate**



A solution of the product from step (i) (1.61g), N-(tert-butoxycarbonyl)-ethylenediamine (1g) and sodium triacetoxyborohydride (2.12g) in dichloromethane (20ml) was stirred at room temperature for 3h. The mixture was partitioned between water and ethyl acetate, the organic layer dried and evaporated under reduced pressure. Yield 1.28g.

MS: APCI(+ve) 402/4 (M+1)

(iii) **N-1-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-1,2-ethanediamine, tri-trifluoroacetate salt**



15 The product from step (ii) (1.28g) was treated with trifluoroacetic acid (5ml) in dichloromethane (10ml). After 20h, the solution was evaporated, the residue triturated with ether and the solid (1.62g) collected.

MS: APCI(+ve) 302/4 (M+1)

20

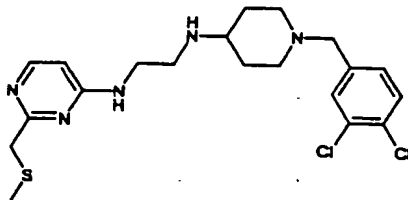
(iv) **Examples 74-93**

The product from step (iii) (0.0026g), the appropriate activated halo-aromatic (1.25 equivalents) and diisopropylethylamine (10 equivalents) in 1-methyl-2-pyrrolidinone (0.15ml) was heated at 100°C for 20h. The reaction mixture was evaporated to dryness and the residue dissolved in dimethylsulphoxide (0.4ml).

25

Example 74

N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[2-[(methylsulfonyl)methyl]-4-pyrimidinyl]-1,2-ethanediamine

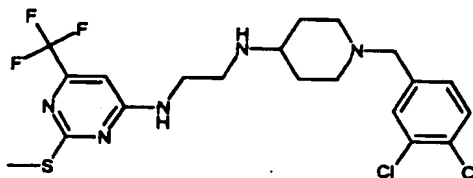


MS: APCI(+ve) 440(M+1)

5

Example 75

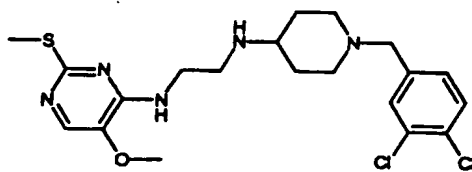
N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[2-(methylsulfonyl)-6-(trifluoromethyl)-4-pyrimidinyl]-1,2-ethanediamine



10 MS: APCI(+ve) 494(M+1)

Example 76

N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[5-methoxy-2-(methylsulfonyl)-4-pyrimidinyl]-1,2-ethanediamine



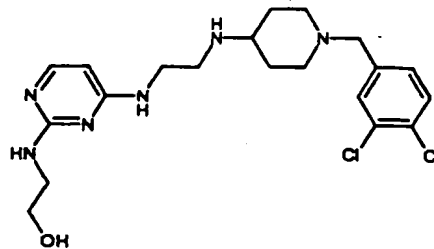
15

MS: APCI(+ve) 456(M+1)

Example 77

2-([4-[(2-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)ethyl]amino]-2-pyrimidinyl]amino)-1-ethanol

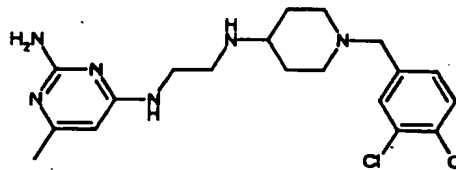
20



MS: APCI(+ve) 439(M+1)

Example 78

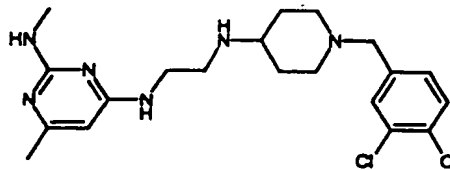
5 **N⁴-(2-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)ethyl)-6-methyl-2,4-pyrimidinediamine**



MS: APCI(+ve) 409(M+1)

10 **Example 79**

N⁴-(2-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)ethyl)-N²,6-dimethyl-2,4-pyrimidinediamine

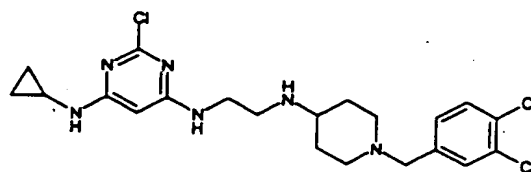


MS: APCI(+ve) 423(M+1)

15

Example 80

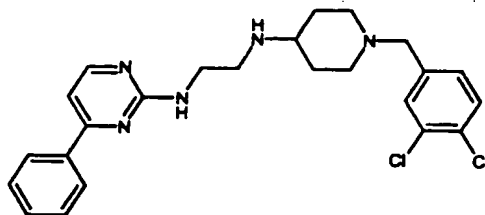
2-Chloro-N⁴-cyclopropyl-N⁶-(2-([1-(3,4-dichlorobenzyl)-4-piperidinyl]amino)ethyl)-4,6-pyrimidinediamine



MS: APCI(+ve) 471(M+1)

Example 81

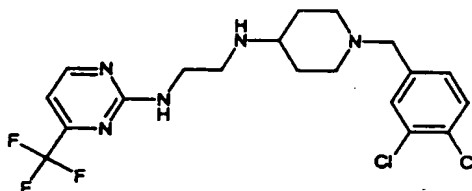
5 **N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-(4-phenyl-2-pyrimidinyl)-1,2-ethanediamine**



MS: APCI(+ve) 456(M+1)

10 **Example 82**

N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-[4-(trifluoromethyl)-2-pyrimidinyl]-1,2-ethanediamine



MS: APCI(+ve) 448(M+1)

15

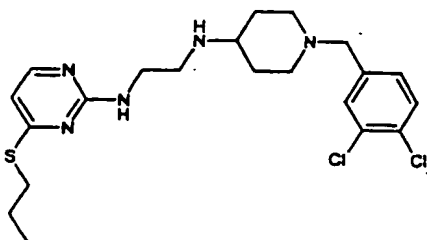
Example 83

N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-[4-(propylsulfanyl)-2-pyrimidinyl]-1,2-ethanediamine

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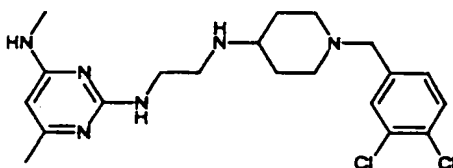
55



MS: APCI(+ve) 454(M+1)

Example 84

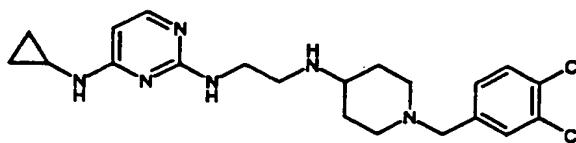
- 5 **N²-(2-([1-(3,4-Dichlorobenzyl)-4-piperidinyl]amino)ethyl)-N⁴,6-dimethyl-2,4-pyrimidinediamine**



MS: APCI(+ve) 423(M+1)

10 **Example 85**

- N⁴-Cyclopropyl-N²-(2-([1-(3,4-dichlorobenzyl)-4-piperidinyl]amino)ethyl)-2,4-pyrimidinediamine**



MS: APCI(+ve) 435(M+1)

15

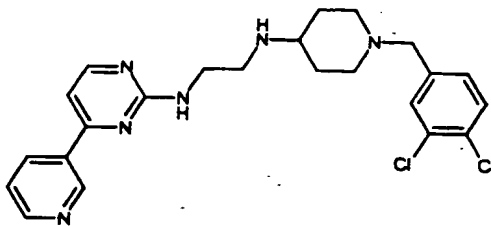
Example 86

- N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-[4-(3-pyridinyl)-2-pyrimidinyl]-1,2-ethanediamine**

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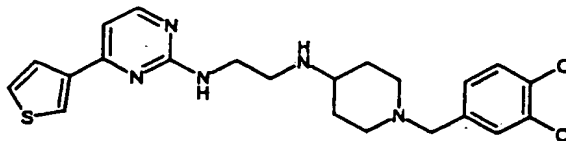
56



MS: APCI(+ve) 457(M+1)

Example 87

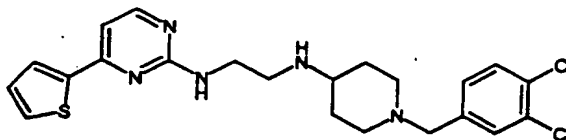
5 **N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-[4-(3-thienyl)-2-pyrimidinyl]-1,2-ethanediamine**



MS: APCI(+ve) 462(M+1)

10 **Example 88**

N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-[4-(2-thienyl)-2-pyrimidinyl]-1,2-ethanediamine

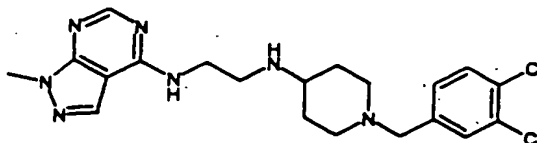


MS: APCI(+ve) 462(M+1)

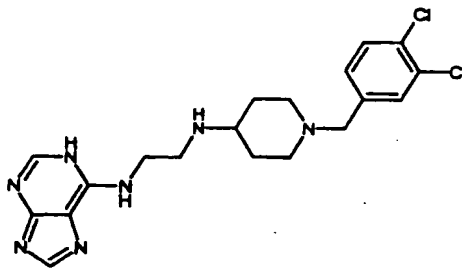
15

Example 89

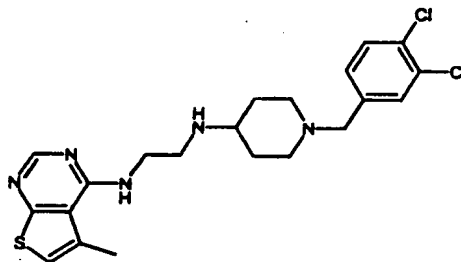
N¹-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N²-(1-methyl-1H-pyrazolo[3,4-d]pyrimidin-4-yl)-1,2-ethanediamine



20 MS: APCI(+ve) 434(M+1)

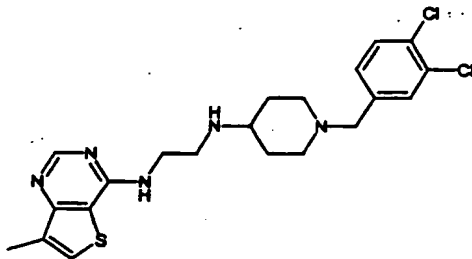
Example 90**N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(1H-purin-6-yl)-1,2-ethanediamine**

5 MS: APCI(+ve) 420(M+1)

Example 91**N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(5-methylthieno[2,3-d]pyrimidin-4-yl)-1,2-ethanediamine**

10

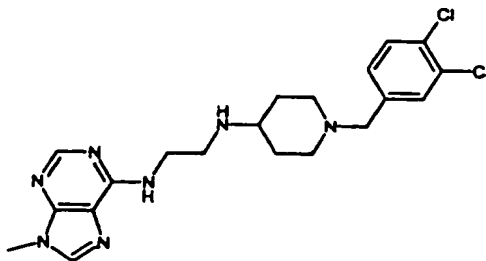
MS: APCI(+ve) 450(M+1)

Example 92**N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(7-methylthieno[3,2-d]pyrimidin-4-yl)-**15 **1,2-ethanediamine**

MS: APCI(+ve) 450(M+1)

Example 93

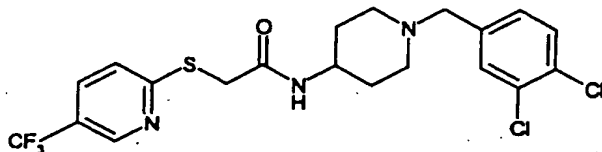
N¹-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N²-(9-methyl-9H-purin-6-yl)-1,2-ethanediamine



MS: APCI(+ve) 434(M+1)

Example 94

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[[5-(trifluoromethyl)-2-pyridinyl]sulfanyl]acetamide



Carbonyldiimidazole (0.105g) was added to a stirred solution of 2-[[5-(trifluoromethyl)-2-pyridinyl]sulfanyl]acetic acid (0.166g) in dimethylformamide (2ml). After 1h a solution of the product from Example 1 step (ii) (0.3g) in a solution of dimethylformamide and diisopropylethylamine (2 equivalents) (1.5ml) was added and stirred at room temperature for 2h. The mixture was partitioned between water and ethyl acetate, the organic layer washed with water, dried and evaporated under reduced pressure. The residue was triturated with ether and collected. Yield 0.084g as a solid.

MS: APCI(+ve) 478/80 (M+1)

¹H NMR: δ (DMSO-d₆) 8.76(s, 1H), 8.11(d, 1H), 8.02(dd, 1H), 7.59-7.53(m, 3H), 7.29(dd, 1H), 3.91(s, 1H), 3.58-3.45(m, 1H), 3.44(s, 2H), 2.70(br d, 2H), 2.03(br t, 2H), 1.70(br d, 2H), 1.46-1.37(m, 2H).

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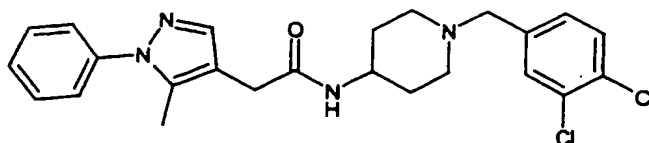
PCT/GB00/03179

59

MP: 98°C

Example 95

5 **N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(5-methyl-1-phenyl-1H-pyrazol-4-yl)acetamide**



The title compound was prepared from the product of Example 1 step (ii) (0.3g) and of 2-(5-methyl-1-phenyl-1H-pyrazol-4-yl)acetic acid (0.151g) using the method of Example 94. Yield 0.18g as a solid.

10 MS: APCI(+ve) 457/9 (M+1)

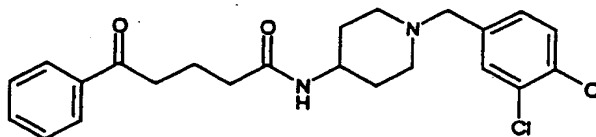
¹H NMR: δ (DMSO-d₆) 7.90(d, 1H), 7.59-7.38(m, 8H), 7.29(dd, 1H), 3.54-3.50(m, 1H), 3.45(s, 2H), 3.24(s, 2H), 2.72(br d, 2H), 2.24(s, 3H), 2.03(br t, 2H), 1.72(br d, 2H), 1.46-1.37(m, 2H).

MP: 165°C

15

Example 96

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-5-oxo-5-phenylpentanamide



20 The title compound was prepared from the product of Example 1 step (ii) (0.3g) and of 5-oxo-5-phenylpentanoic acid (0.134g) using the method of Example 94. Yield 0.149g as a solid.

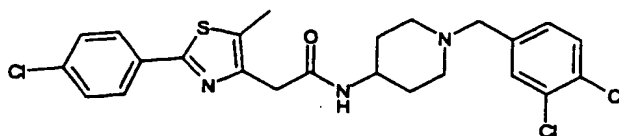
MS: APCI(+ve) 433/5 (M+1)

¹H NMR: δ (DMSO-d₆) 7.96-7.93(m, 2H), 7.72(d, 1H), 7.65-7.50(m, 5H), 7.28(dd, 1H), 3.57-3.48(m, 1H), 3.44(s, 2H), 3.01(t, 2H), 2.72-2.67(m, 2H), 2.13(t, 2H), 2.04-1.98(m, 2H), 1.86-1.79(m, 2H), 1.69(br s, 2H), 1.41-1.32(m, 2H).

25 MP: 130°C

Example 97

2-[2-(4-Chlorophenyl)-5-methyl-1,3-thiazol-4-yl]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]acetamide



5

The title compound was prepared from the product of Example 1 step (ii) (0.3g) and 2-[2-(4-chlorophenyl)-5-methyl-1,3-thiazol-4-yl]acetic acid (0.187g) using the method of Example 94. Yield 0.1g as a solid.

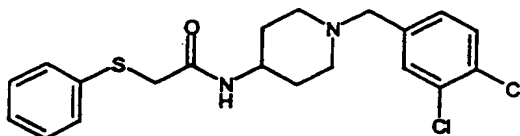
MS: APCI(+ve) 510/2 (M+1)

¹H NMR: δ (DMSO-d₆) 8.00(d, 1H), 7.85-7.82(m, 2H), 7.59-7.52(m, 4H), 7.29(dd, 1H), 3.57-3.51(m, 3H), 3.44(s, 2H), 2.72(br d, 2H), 2.41(s, 3H), 2.06(t, 2H), 1.73(br d, 2H), 1.48-1.38(m, 2H).

MP: 170°C

Example 98

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(phenylsulfanyl)acetamide



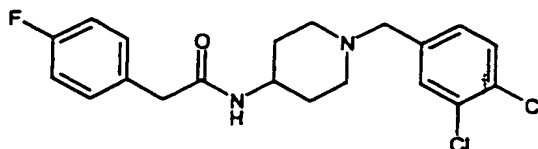
20

The title compound was prepared from the product of Example 1 step (ii) (0.3g) and 2-(phenylsulfanyl)acetic acid (0.118g) using the method of Example 94. Yield 0.056g as a solid.

MS: APCI(+ve) 409 (M+1)

¹H NMR: δ (DMSO-d₆) 8.00(d, 1H), 7.57(d, 1H), 7.53(d, 1H), 7.36-7.27(m, 5H), 7.20-7.16(m, 1H), 3.61(s, 2H), 3.55-3.47(m, 1H), 3.44(s, 2H), 2.69-2.66(m, 2H), 2.02(t, 2H), 1.67-1.64(m, 2H), 1.41-1.31(m, 2H).

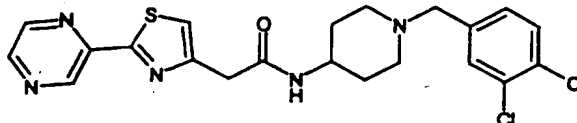
25 MP: 97-99°C

Example 99**N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-(4-fluorophenyl)acetamide**

The title compound was prepared from the product of Example 1 step (ii) (0.3g) and 2-(4-fluorophenyl)acetic acid (0.108g) using the method of Example 94. Yield 0.15g as a solid.
 MS: APCI(+ve) 395 (M+1).

¹H NMR: δ (DMSO-d₆) 7.98(d, 1H), 7.57(d, 1H), 7.53(d, 1H), 7.30-7.25(m, 3H), 7.13-7.07(m, 2H), 3.54-3.48(m, 1H), 3.45(s, 2H), 3.37(s, 2H), 2.72-2.69(m, 2H), 2.02(t, 2H), 1.71-1.68(m, 2H), 1.44-1.34(m, 2H).

MP: 144-7°C

Example 100**N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-[2-(2-pyrazinyl)-1,3-thiazol-4-yl]acetamide**

The title compound was prepared from the product of Example 1 step (ii) (0.3g) and 2-[2-(2-pyrazinyl)-1,3-thiazol-4-yl]acetic acid (0.155g) using the method of Example 94. Yield 0.08g as a solid.

MS: APCI(+ve) 462 (M+1)

¹H NMR: δ (DMSO-d₆) 9.25(d, 1H), 8.74-8.71(m, 2H), 8.07(d, 1H), 7.64(s, 1H), 7.59-7.54(m, 2H), 7.31-7.28(m, 1H), 3.69(s, 2H), 3.59-3.54(m, 1H), 3.45(s, 2H), 2.74-2.71(m, 2H), 2.04(t, 2H), 1.76-1.74(m, 2H), 1.49-1.39(m, 2H).

MP: 186-9°C

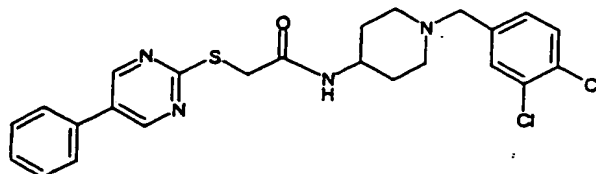
Example 101

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-2-[(5-phenyl-2-pyrimidinyl)sulfanyl]acetamide

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62



The title compound was prepared from the product of Example 1 step (ii) (0.3g) and 2-[(5-phenyl-2-pyrimidinyl)sulfanyl]acetic acid (0.172g) using the method of Example 94.

Yield 0.115g as a solid.

5 MS: APCI(+ve) 487/9 (M+1)

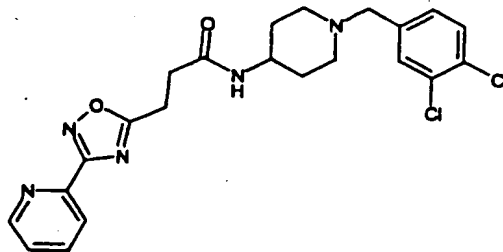
¹H NMR: δ (DMSO-d₆) 8.96(s, 2H), 8.09(d, 1H), 7.78-7.75(m, 2H), 7.58-7.43(m, 5H), 7.28(dd, 1H), 3.91(s, 2H), 3.59-3.52(m, 1H), 3.44(s, 2H), 2.70(br d, 2H), 2.03(br t, 2H), 1.72(br d, 2H), 1.47-1.38(m, 2H).

MP: 157°C

10

Example 102

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide



15 The title compound was prepared from the product of Example 1 step (ii) (0.9g) and 3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanoic acid (0.3g) using the method of Example 94.

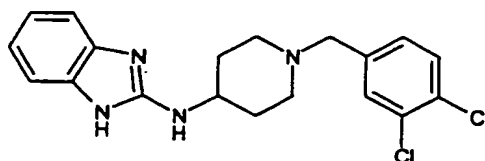
Yield 0.074g as a solid.

MS: APCI(+ve) 460/2 (M+1)

¹H NMR: δ (DMSO-d₆) 8.76-8.74(m, 1H), 8.05-7.99(m, 2H), 7.94(d, 1H), 7.61-7.56(m, 2H), 7.52(d, 1H), 7.28(dd, 1H), 3.56-3.48(m, 1H), 3.43(s, 2H), 3.19(t, 2H), 2.71-2.66(m, 4H), 2.03(t, 2H), 1.69(br d, 2H), 1.42-1.33(m, 2H).

20

MP: 155°C

Example 103**N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-1H-benzimidazol-2-amine**

5

(i) Ethyl 4-(1H-benzimidazol-2-ylamino)-1-piperidinecarboxylate

A solution of 2-chlorobenzimidazole (1g) and ethyl 4-amino-1-piperidinecarboxylate (2g) in 1-methyl-2-pyrrolidinone was heated at 130°C for 24h. The mixture was partitioned between water and ethyl acetate, the organic layer washed with water, dried and evaporated under reduced pressure. Purification was by chromatography eluting with 1% triethylamine/5% methanol in dichloromethane. Yield 0.630g as a solid.

TOF MS ES+ 289.1652 (M+1)

(ii) N-(4-Piperidiny)-1H-benzimidazol-2-amine, dihydrochloride salt

The product from step (i) (0.58g) was heated under reflux with 5M hydrochloric acid (20ml) for 24h. The solvent was evaporated under reduced pressure, the residue azeotroped with toluene, washed with ether. Yield 0.58g as a solid.

TOF MS ES+ 217.1452 (M+1)

(iii) N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-1H-benzimidazol-2-amine

Triethylamine (0.223ml) was added to a stirred suspension of the product from step (ii) (0.2g) in dimethylformamide. After 5min 3,4-dichlorobenzaldehyde (0.175g) then sodium triacetoxyborohydride (0.212g) was added and the mixture stirred at room temperature for 3h. The mixture was partitioned between 2M hydrochloric acid and ether, the aqueous layer was basified with aqueous sodium hydrogencarbonate and extracted with ethyl acetate. The organic layer was dried and evaporated under reduced pressure. The residue was triturated with ethyl acetate/ether and the solid collected. Yield 0.045g.

TOF MS ES+ 375.4257 (M+1)

25

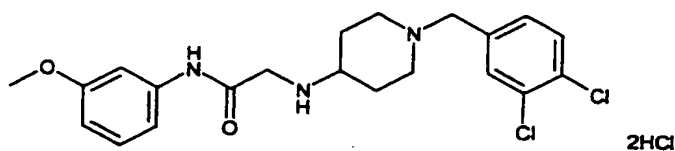
$^1\text{H NMR}$: δ (DMSO- d_6) 10.6(br s, 1H), 7.60-7.56(m, 2H), 7.32(dd, 1H), 7.12-7.09(m, 2H), 6.86-6.83(m, 2H), 6.49(d, 1H), 3.55-3.49(m, 3H), 2.79-2.71(m, 2H), 2.13-1.91(m, 4H), 1.56-1.46(m, 2H).

MP: 125°C

5

Example 104

2-[[1-(3,4-Dichlorobenzyl)-4-piperidiny]amino]-N-(3-methoxyphenyl)acetamide, dihydrochloride salt



10 2-Chloro-N-(3-methoxyphenyl)-acetamide (0.241g) was added to a stirred solution of the product of Example 1 step (ii) (dihydrochloride salt) (0.4g), triethylamine (0.608g) in 1-methyl-2-pyrrolidinone (5ml). The reaction mixture was heated at 80°C for 6h then partitioned between ethyl acetate and brine. The organic layer was washed with brine, dried and evaporated under reduced pressure. Purification was by chromatography eluting
15 with chloroform/isohexane/triethylamine/methanol 30:15:3:0.5. The resulting product was converted to the hydrochloride salt using ethereal hydrogenchloride. Yield 0.135g.

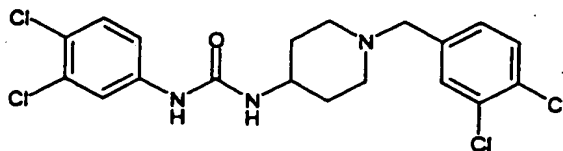
TOF MS ES+ 422.1406 (M+1)

$^1\text{H NMR}$: δ (DMSO- d_6) 11.21(br s, 1H), 10.82(s, 1H), 9.53(br s, 2H), 7.95(s, 1H), 7.75(d, 1H), 7.60(d, 1H), 7.31-7.23(m, 2H), 7.15(d, 1H), 6.70(dd, 1H), 4.28(br s, 2H), 3.97(br ,
20 H), 3.73(s, 3H), 2.96(br, 2H), 2.28-2.05(m, 4H).

MP: 274-6°C

Example 105

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-N'-(3,4-dichlorophenyl)urea



25

3,4-Dichlorophenyl isocyanate (0.081g) was added to a stirred solution of the product from Example 1 step (ii) (0.13g), diisopropylethylamine (0.2g) in dichloromethane (4ml). The reaction mixture was stirred for 20h and the solvent removed under reduced pressure. Purification was by chromatography eluting with 5% methanol/dichloromethane. Yield 0.09g as a solid.

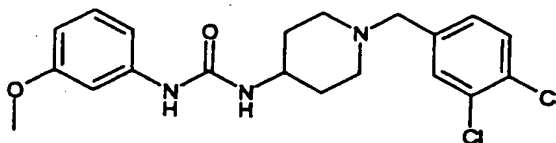
TOF MS ES+ 446.0360 (M+1)

$^1\text{H NMR}$: δ (DMSO-d₆) 8.65(s, 1H), 7.82(d, 1H), 7.59(d, 1H), 7.54(s, 1H), 7.31(d, 1H), 7.22(dd, 1H), 6.26(d, 1H), 3.45(br s, 3H), 2.67(m, 2H), 2.11(m, 2H), 1.81(m, 2H), 1.40(m, 2H).

MP: 189-190°C

Example 106

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N'-(3-methoxyphenyl)urea



3-Methoxyphenyl isocyanate (0.064g) was added to a stirred solution of the product from Example 1 step (ii) (0.13g), diisopropylethylamine (0.2g) in dichloromethane (4ml). The reaction mixture was stirred for 20h and the solvent removed under reduced pressure. Purification was by chromatography eluting with 5% methanol/dichloromethane. Yield 0.09g as a solid.

MS: APCI(+ve) 408/10 (M+1)

$^1\text{H NMR}$: δ (DMSO-d₆) 8.32(s, 1H), 7.59(d, 1H), 7.55(d, 1H), 7.31(dd, 1H), 7.13(m, 1H), 7.09(d, 1H), 6.83(dd, 1H), 6.47(dd, 1H), 6.09(d, 1H), 3.69(s, 3H), 3.46(m, 3H), 2.66(m, 2H), 2.13(m, 2H), 1.81(m, 2H), 1.42(m, 2H).

MP: 178-9°C

Example 107

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-N-(4-methoxybenzyl)amine, dihydrochloride salt

147	3-F-4-CH ₃ O-C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
148	3-CH ₃ -C ₆ H ₄	m=0	4	3,4-Cl ₂ -C ₆ H ₃
149	3-OH-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
150	4-(C ₆ H ₅ -CH ₂ O)-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
151	4-(3-NO ₂ -C ₆ H ₄)-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
152	2,5-(CH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
153	4-I-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
154	3-Br-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
155	2-CH ₃ -3-NO ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
156	3-OH-4-OCH ₃ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
157	3-F-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
158	2-F-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
159	3,5-(OCH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
160	3-Cl-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
161	phenyl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
162	3,5-(CH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
163	3-OCH ₃ -C ₆ H ₄	m=0	2	3,4-Cl ₂ -C ₆ H ₃
164	2,4-F ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
165	2-OCH ₃ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
166	3,4-F ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
167	3,5-F ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
168	Pyridin-3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
169	Pyridin-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
170	5-Br-pyridin-3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
171	2,4-(OCH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
172	4-(benzyloxy)phenyl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
173	3-(benzyloxy)phenyl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
174	2-methyl-naphth-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
175	2-CH ₃ CH ₂ O-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
176	3,4-(OCH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
177	4-CH ₃ (CH ₂) ₃ O-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃

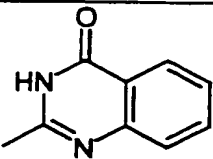
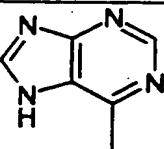
178	Indol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
179	2-NO ₂ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
180	Thien-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
181	3-Cl-4-OH-C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
182	2,4-Cl ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
183	2,6-Cl ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
184	2-Br-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
185	3,4-Cl ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
186	3-Br-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
187	3,5-F ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
188	3-NH ₂ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
189	2-(ClCH ₂ C(O)NH)- thiazol-4-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
190	3-Cl-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
191	2,5-(OCH ₃) ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
192	4-OH-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
193	Indol-3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
194	5-OCH ₃ -indol-3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
195	Naphth-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
196	4-CH ₃ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
197	3,4,5-(OCH ₃) ₃ -C ₆ H ₂	m=0	1	3,4-Cl ₂ -C ₆ H ₃
198	4-CH ₃ (CH ₂) ₃ O-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
199	4-S(O) ₂ CH ₃ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
200	2,4,6-(CH ₃) ₃ -C ₆ H ₂	m=0	1	3,4-Cl ₂ -C ₆ H ₃
201	4-F-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
202	2-(pyrazin-2-yl)-thiazol-4- yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
203	2-CH ₃ -5-(CH ₃) ₂ CH-indol- 3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
204	5-(pyrrolidin-1-yl)- tetrazol-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃

205	5-(4-CH ₃ -phenyl)-tetrazol-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
206	3,5-F ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
207	3-OCH ₃ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
208	5-Cl-benzo[b]thiophen-3-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
209	3,4-Cl ₂ -C ₆ H ₃	m=0	1	3,4-Cl ₂ -C ₆ H ₃
210	2-phenyl-5-methyl-thiazol-4-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
211	4-OCF ₃ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
212	3-methyl-5-Cl-benzo[b]thiophen-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
213	3-methyl-benzo[b]thiophen-2-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
214	2-NO ₂ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
215	3-NO ₂ -1,2,4-triazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
216	3,4-(NO ₂) ₂ -5-CH ₃ -pyrazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
217	4-(CH ₃) ₂ CH(CH ₂) ₂ O-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
218	2,3-(CH ₃) ₂ -indol-5-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
219	3,5-(CH ₃) ₂ -4-Cl-pyrazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
220	3,5-(CH ₃) ₂ -4-NO ₂ -pyrazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
221	2,4-(NO ₂) ₂ -imidazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
222	4-NO ₂ -imidazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
223	3,5-(CH ₃) ₂ -pyrazol-1-yl	m=0	1	3,4-Cl ₂ -C ₆ H ₃
224	4-CH ₃ (CH ₂) ₅ -C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
225	2-CN-C ₆ H ₄	m=0	1	3,4-Cl ₂ -C ₆ H ₃
226	4-Cl-C ₆ H ₄	O	1	4-Cl-C ₆ H ₄
227	4-Cl-C ₆ H ₄	O	1	2-Br-C ₆ H ₄

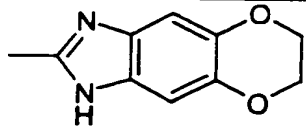
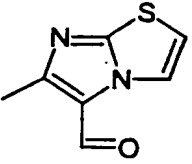
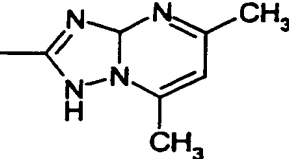
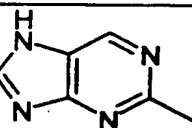
228	4-Cl-C ₆ H ₄	O	1	3-(CO ₂ CH ₃)-4-Br-C ₆ H ₄
229	4-Cl-C ₆ H ₄	O	1	4-NO ₂ -C ₆ H ₄
230	4-Cl-C ₆ H ₄	O	1	3-benzoyl-phenyl
231	4-Cl-C ₆ H ₄	O	1	5-OCH ₃ - benzimidazol-2-yl
232	4-Cl-C ₆ H ₄	O	1	4-Br-C ₆ H ₄
233	4-Cl-C ₆ H ₄	O	1	4-(1,2,3-thiadiazol- 4-yl)-phenyl
234	4-Cl-C ₆ H ₄	O	1	4-CH ₃ -C ₆ H ₄
235	4-Cl-C ₆ H ₄	O	1	4-(2,6-Cl ₂ - C ₆ H ₃)CH ₂ S(O) ₂ - C ₆ H ₄
236	4-Cl-C ₆ H ₄	O	1	3,5-Br ₂ -C ₆ H ₃
237	4-Cl-C ₆ H ₄	O	1	Indan-5-yl
238	4-Cl-C ₆ H ₄	O	1	2-F-3-Cl-C ₆ H ₃
239	4-Cl-C ₆ H ₄	O	1	benzofurazan-5-yl
240	4-Cl-C ₆ H ₄	O	1	7-Cl-quinolin-2-yl
241	4-F-C ₆ H ₄	m=0	1	2,5-Cl ₂ -C ₆ H ₃
242	4-F-C ₆ H ₄	m=0	1	2,3-Cl ₂ -C ₆ H ₃
243	4-F-C ₆ H ₄	m=0	1	4-F-C ₆ H ₄
244	4-F-C ₆ H ₄	m=0	1	3-CO ₂ CH ₃ -4-Br- C ₆ H ₃
245	4-F-C ₆ H ₄	m=0	1	4-NO ₂ -C ₆ H ₄
246	4-F-C ₆ H ₄	m=0	1	3-benzoyl-phenyl
247	4-F-C ₆ H ₄	m=0	1	4-CH ₃ -naphth-1-yl
248	4-F-C ₆ H ₄	m=0	1	3,4-methylene- dioxyphenyl
249	4-F-C ₆ H ₄	m=0	1	5-OCH ₃ - benzimidazol-2-yl
250	4-F-C ₆ H ₄	m=0	1	3-NO ₂ -4-CH ₃ -

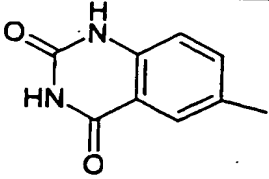
				C ₆ H ₃
251	4-F-C ₆ H ₄	m=0	1	3,4-(CH ₃) ₂ -C ₆ H ₃
252	4-F-C ₆ H ₄	m=0	1	3-CH ₃ -4-OCH ₃ - C ₆ H ₃
253	4-F-C ₆ H ₄	m=0	1	4-(2-C(O)NH ₂ - C ₆ H ₄)-C ₆ H ₄
254	4-F-C ₆ H ₄	m=0	1	4-Br-C ₆ H ₄
255	4-F-C ₆ H ₄	m=0	1	4-(2,6-Cl ₂ - C ₆ H ₄)CH ₂ S(O) ₂ - C ₆ H ₄
256	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	4-Cl-C ₆ H ₄
257	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3-Cl-4-OCH ₃ -C ₆ H ₃
258	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	2,3-Cl ₂ -C ₆ H ₃
259	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	4-F-C ₆ H ₄
260	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3-CF ₃ -C ₆ H ₄
261	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	4-NO ₂ -C ₆ H ₄
262	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3-benzoyl-phenyl
263	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3,4-methylene- dioxypheyl
264	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3,5-(CH ₃) ₂ -C ₆ H ₃
265	3-(pyridin-2-yl)-1,2,4- oxadiazol-5-yl	m=0	2	3-NO ₂ -4-CH ₃ - C ₆ H ₃
266	3-(pyridin-2-yl)-1,2,4-	m=0	2	3,4-(CH ₃) ₂ -C ₆ H ₃

	oxadiazol-5-yl			
267	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	3-CH ₃ -C ₆ H ₄
268	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	3-CH ₃ -4-OCH ₃ -C ₆ H ₄
269	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	4-Br-C ₆ H ₄
270	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	Indan-5-yl
271	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	4-CF ₃ -C ₆ H ₄
272	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	Naphth-2-yl
273	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	4-CH ₃ -C ₆ H ₄
274	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	benzofurazan-5-yl
275	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	3,4-F ₂ -C ₆ H ₃
276	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	7-Cl-quinolin-2-yl
277	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	3-Cl-C ₆ H ₄
278	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	4-CF ₃ -C ₆ H ₄
279	3-(pyridin-2-yl)-1,2,4-oxadiazol-5-yl	m=0	2	4-CH ₃ -C ₆ H ₄
280	4-OCH ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
281	4-Cl-C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
282	4-NO ₂ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
283	4-NHC(O)CH ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃

284	4-O(CH ₂) ₂ CH ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
285	3-CO ₂ CH ₂ CH ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
286	2-C(CH ₃) ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
287	2-NHC(O)CH ₃ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
288	3,5-(OCH ₃) ₂ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
289	2-OCH ₃ -5-NO ₂ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
290	4-CN-C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
291	2-Cl-5-CF ₃ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
292	2-NO ₂ -5-CH ₃ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
293	3-Cl-5-OCH ₃ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
294	3-NO ₂ -C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
295	3-Br-C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
296	4-I-C ₆ H ₄	O	1	3,4-Cl ₂ -C ₆ H ₃
297	3,5-F ₂ -C ₆ H ₃	O	1	3,4-Cl ₂ -C ₆ H ₃
298	4,6-(NH ₂) ₂ -pyrimidin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
299	Benzimidazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
300	Thiazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
301		S	1	3,4-F ₂ -C ₆ H ₃
302	5-NO ₂ -benzimidazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
303	Pyridin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
304		S	1	3,4-F ₂ -C ₆ H ₃
305	1H-1,2,4-triazol-3-yl	S	1	3,4-F ₂ -C ₆ H ₃
306	Pyrimidin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
307	1-phenyl-tetrazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
308	4,6-(CH ₃) ₂ -pyrimidin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃

309	4-(thiophen-2-yl)- pyrimidin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
310	2-(cyclopropyl-CH ₂ S)- 1,3,4-thiadiazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
311	4-methyl-3-(thiophen-2- yl)-1,2,4-triazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
312	3-CN-6-(CH ₃ C(O))- pyridin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
313	1H-pyrazolo[3,4- d]pyrimidin-4-yl	S	1	3,4-F ₂ -C ₆ H ₃
314	5-OCH ₃ -benzimidazol-2- yl	S	1	3,4-F ₂ -C ₆ H ₃
315	5-F-6-Cl-benzimidazol-2- yl	S	1	3,4-F ₂ -C ₆ H ₃
316	4,5-dihydrothiazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
317	1H-5-phenyl-1,2,4-triazol- 3-yl	S	1	3,4-F ₂ -C ₆ H ₃
318	2-(thiophen-2-yl)-1,3,4- oxadiazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
319	Quinoxalin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
320	2,5-Cl ₂ -C ₆ H ₃	S	1	3,4-F ₂ -C ₆ H ₃
321	2-(pyridin-2-yl)-1,3,4- oxadiazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
322	7-CF ₃ -quinolin-4-yl	S	1	3,4-F ₂ -C ₆ H ₃
323	2-(pyridin-2-yl)-4-CH ₃ - pyrimidin-6-yl	S	1	3,4-F ₂ -C ₆ H ₃
324	Naphth-1-yl	S	1	3,4-F ₂ -C ₆ H ₃
325	3,4-(OCH ₃) ₂ -C ₆ H ₃	S	1	3,4-F ₂ -C ₆ H ₃
326	1,3,4-thiadiazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
327	3-CF ₃ -C ₆ H ₄	S	1	3,4-F ₂ -C ₆ H ₃

328		S	1	3,4-F ₂ -C ₆ H ₃
329	3,4-Cl ₂ -C ₆ H ₃	S	1	3,4-F ₂ -C ₆ H ₃
330	3-CN-5-CH ₃ -pyridin-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
331	4-phenyl-thiazol-2-yl	S	1	3,4-F ₂ -C ₆ H ₃
332		S	1	3,4-F ₂ -C ₆ H ₃
333	2-CH ₃ -1,3,4-thiadiazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
334		S	1	3,4-F ₂ -C ₆ H ₃
335		S	1	3,4-F ₂ -C ₆ H ₃
336	2-phenoxy-phenyl	S	1	3,4-F ₂ -C ₆ H ₃
337	2-OCH ₃ -C ₆ H ₄	S	1	3,4-F ₂ -C ₆ H ₃
338	2-CH ₃ -4-Cl-C ₆ H ₃	S	1	3,4-F ₂ -C ₆ H ₃
339	2-CH ₃ -6-Cl-C ₆ H ₃	S	1	3,4-F ₂ -C ₆ H ₃
340	2-(HC≡C-CH ₂ S)-1,3,4-thiadiazol-5-yl	S	1	3,4-F ₂ -C ₆ H ₃
341	2-CO ₂ CH ₃ -C ₆ H ₄	S	1	3,4-F ₂ -C ₆ H ₃
342	4-CN-C ₆ H ₄	O	1	3,4-F ₂ -C ₆ H ₃
343	4-((CH ₃) ₂ NCH ₂)-C ₆ H ₄	O	1	3,4-F ₂ -C ₆ H ₃

344		O	1	3,4-F ₂ -C ₆ H ₃
345	3-CH ₂ OH-C ₆ H ₄	O	1	3,4-F ₂ -C ₆ H ₃
346	2-OCH ₂ CH ₂ OH-C ₆ H ₄	O	1	3,4-F ₂ -C ₆ H ₃
347	4-CH ₃ (CH ₂) ₂ O-C ₆ H ₄	O	1	3,4-F ₂ -C ₆ H ₃
348	3-Cl-5-OCH ₃ -C ₆ H ₃	O	1	3,4-F ₂ -C ₆ H ₃

General Preparation of Examples 108-225

PyBroP® (bromo-tris-pyrrolidino-phosphonium hexafluorophosphate, 2 equivalents) was added to a solution of the product from Example 1 step (ii) (hydrochloride salt, 1mg) the appropriate acid (2 equivalents) and triethylamine in 1-methyl-2-pyrrolidone (0.2ml) and was left for 24h. The reaction mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (0.3ml).

General Preparation of Examples 225-240

10 Step i: *tert*-Butyl 4-[[[(4-chlorophenoxy)acetyl]amino]-1-piperidinecarboxylate

Prepared following the method of Example 94 using (4-chlorophenoxy)acetic acid (0.50g), 1,1-carbonyldiimidazole (0.50g) and *tert*-butyl 4-amino-1-piperidinecarboxylate (0.46g) to give the subtitle compound (0.54g).

¹H NMR (399.978 MHz, CDCl₃) δ 1.34 – 1.40 (2H, m), 1.46 (9H, s), 1.90 – 1.95 (2H, m), 2.86 – 2.88 (2H, m), 4.01 – 4.14 (3H, m), 4.45 (2H, s), 6.38 – 6.41 (1H, m), 6.84 – 6.87 (2H, m), 7.26 – 7.30 (2H, m).

Step ii: 2-(4-chlorophenoxy)-*N*-(4-piperidiny)acetamide

Prepared following the method of Example 1 step (ii) using *tert*-butyl 4-[[[(4-chlorophenoxy)acetyl]amino]-1-piperidinecarboxylate (0.52g) to give the subtitle compound (0.35g).

¹H NMR (399.978 MHz, CDCl₃) δ 1.32 – 1.45 (2H, m), 1.93 – 1.97 (2H, m), 2.68 – 2.77 (2H, m), 3.07 – 3.11 (2H, m), 3.91 – 4.04 (1H, m), 4.45 (2H, s), 6.38 – 6.40 (1H, m), 6.84 – 6.89 (2H, m), 7.26 – 7.31 (2H, m).

Step iii: Final product

A mixture of the product from step (ii) (1.07mg), the appropriate alkyl halide (2 equivalents) and *N,N*-diisopropylethylamine (3 equivalents) in 1-methyl-2-pyrrolidinone (0.18ml) was left at room temperature for 24h. The mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (0.4ml).

General Preparation of Examples 241-255

A mixture of 2-(4-fluorophenyl)-*N*-(4-piperidiny)acetamide (WO97/36871; 0.94mg), the appropriate alkyl halide (2 equivalents) and *N,N*-diisopropylethylamine (3 equivalents) in 1-methyl-2-pyrrolidinone (0.18ml) was left at room temperature for 24h. The mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (0.4ml).

General Preparation of Examples 256-279

Step i: *tert*-Butyl 4-({3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanoyl} amino)-1-piperidinecarboxylate

3-[3-(2-Pyridinyl)-1,2,4-oxadiazol-5-yl]propanoic acid (0.60g) was dissolved in dichloromethane (10ml). 1,1-Carbonyldiimidazole (0.33g) was added followed by *tert*-butyl 4-amino-1-piperidinecarboxylate hydrochloride (0.5g) and triethylamine (0.31ml). After 2hours water, brine and dichloromethane were added and the phases separated. The organic phase was dried, filtered and evaporated and the residue was purified by chromatography eluting with ethyl acetate : methanol (33:1) to give the subtitle compound (0.40g).

¹H NMR (399.98 MHz, DMSO) δ 1.22 - 1.24 (2H, m), 1.39 (9H, s), 1.62 - 1.71 (2H, m), 2.66 - 2.71 (4H, m), 3.18 - 3.23 (2H, m), 3.65 - 3.83 (3H, m), 7.58 - 7.63 (1H), 8.01 - 8.04 (3H, m), 8.74 - 8.76(1H, m).

Step ii: *N*-(4-Piperidiny)-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide *tert*-Butyl 4-({3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanoyl} amino)-1-piperidinecarboxylate (0.40g) was dissolved in dichloromethane (6ml) and trifluoroacetic acid (3ml) was added. After 2hours water, 2N sodium hydroxide and dichloromethane were added and the phases were separated. The organic phase was dried, filtered and evaporated to give the subtitle compound (0.19g).

¹H NMR (399.978 MHz, CDCl₃) δ 1.35 – 1.45 (2H, m), 1.86 – 1.97 (2H, m), 2.69 – 2.84 (4H, m), 3.09 – 3.13 (2H, m), 3.32 – 3.36 (2H, m), 3.86 – 3.95 (1H, m), 5.82 – 5.84 (1H, m), 7.42 – 7.45 (1H, m), 7.83 – 7.87 (1H, m), 8.10 – 8.12 (1H, m), 8.78 – 8.79 (1H, m).

Step iii: Final product

- 5 A mixture of the product from step (ii) (1.21mg), the appropriate alkyl halide (2 equivalents) and *N,N*-diisopropylethylamine (3 equivalents) in 1-methyl-2-pyrrolidinone (0.18ml) was left at room temperature for 24h. The mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (0.4ml).

10 General Preparation of Examples 280-296

Step i: 2-Chloro-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide

Prepared following the general preparation method of Examples 297-357 step (iii) using 1-(3,4-dichlorobenzyl)-4-piperidinamine hydrochloride (2.0g), *N,N*-diisopropylethylamine (5.55 ml) and chloroacetyl chloride (0.55ml) to give the subtitle compound (1.0g).

- 15 ¹H NMR (399.978 MHz, CDCl₃) δ 1.48 – 1.61 (2H, m), 1.91 – 1.94 (2H, m), 1.95 – 2.18 (2H, m), 2.77 – 2.80 (2H, m), 3.44 (2H, s), 3.78 – 3.87 (1H, m), 4.04 (2H, s), 7.13 – 7.16 (1H, m), 7.37 – 7.43 (2H, m).

Step ii: Final Product

- A mixture of the product from step (i) (1.34 mg), the appropriate phenol (1.5 equivalents) and potassium *tert*-butoxide (1.4 equivalents) in 1-methyl-2-pyrrolidinone (0.13ml) was left at room temperature for 24hours. The mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (0.4ml).

General Preparation of Examples 297-340

- 25 Step i: Carbamic acid, [1-[(3,4-difluorophenyl)methyl]-4-piperidinyl]-, 1,1-dimethylethyl ester

- Carbamic acid, 4-piperidinyl-, 1,1-dimethylethyl ester (6.95g) was dissolved in *N,N*-dimethylformamide (70ml). 3,4-Difluorobenzylbromide (4.55ml) and potassium carbonate (16.0g) were added. The mixture was heated to reflux for 16hours, then allowed to cool to room temperature. Ammonium chloride solution was added and the mixture was extracted thrice with ethyl acetate. The organic phases were washed with water (twice) and brine,

then dried, filtered and evaporated. The residue was triturated with ether : *iso*-hexane (1:1) to give the subtitle compound (8.13g)

¹H NMR (399.978 MHz, CDCl₃) δ 1.36 - 1.43 (m, 2H), 1.44 (s, 9H), 1.91 (d, *J* = 11.8 Hz, 2H), 2.08 (td, *J* = 11.4, 2.7 Hz, 2H), 2.75 (d, *J* = 11.3 Hz, 2H), 3.41 (s, 2H), 3.42 - 3.55 (m, 1H), 4.38 - 4.47 (m, 1H), 6.96 - 7.02 (m, 1H), 7.04 - 7.11 (m, 2H), 7.13 - 7.19 (m, 1H)

Step ii: 1-[(3,4-Difluorophenyl)methyl]-piperidin-4-ylamine dihydrochloride

Carbamic acid, [1-[(3,4-difluorophenyl)methyl]-4-piperidinyl]-, 1,1-dimethylethyl ester was suspended in 6N hydrochloric acid (100ml). After 16hours excess hydrochloric acid was evaporated and the residue azeotroped with toluene, dried and evaporated to give the subtitle compound (8.10g).

¹H NMR (399.98 MHz, DMSO) δ 1.91-2.01(2H,m), 2.31-2.47(2H,m), 2.86-3.20(2H,m), 3.54-3.66(3H,m), 4.75-4.83(2H,s), 7.26-7.61(3H,m).

Step iii: 2-Chloro-*N*-[1-[(3,4-difluorophenyl)methyl]-piperidin-4-yl]-acetamide

1-[(3,4-Difluorophenyl)methyl]-piperidin-4-ylamine dihydrochloride (3.18g) was dissolved in tetrahydrofuran (40ml). Diisopropylethylamine (6.84g) and chloroacetyl chloride (1.33g) were added. After 3hours water, brine and ethyl acetate were added the phase were separated. The organic phase was dried, filtered and evaporated and the residue was purified by chromatography eluting with ethyl acetate to give the subtitle compound (0.728g).

¹H NMR (CDCl₃) δ 1.46 - 1.59 (2H, m), 1.93 (2H, dt), 2.14 (2H, td), 2.78 (2H, d), 3.43 (2H, s), 3.76 - 3.91 (1H, m), 4.04 (2H, s), 6.39 - 6.51 (1H, m), 6.98 - 7.02 (1H, m), 7.08 (1H, dd), 7.17 (1H, ddd).

Step iv: Final Product

The product from step (iii) (1.21mg) was dissolved in dimethylsulfoxide (50μl) and diisopropylethylamine (1.55mg, 3 equivalents) was added as a solution in dimethylsulfoxide (50μl). The appropriate thiol was added (1 equivalent) in dimethylsulfoxide (40μl) and the reaction mixture was left at room temperature for 24hours. The reaction mixture was evaporated to dryness and the residue was dissolved in dimethylsulfoxide (400μl).

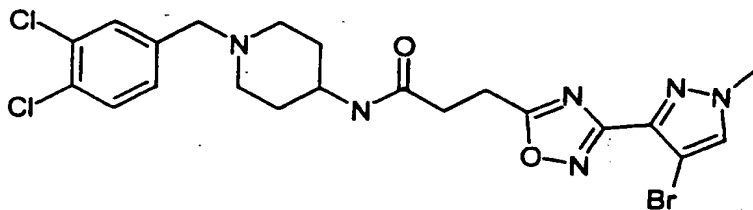
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General Preparation of Examples 341-348

Prepared from the product of general preparation for Examples 297-340 step (iii) and the appropriate phenol following the method of Examples 280-296 step (ii).

Example 351

- 5 3-[3-(4-Bromo-1-methyl-1*H*-pyrazol-3-yl)-1,2,4-oxadiazol-5-yl]-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]propanamide



Step i: Methyl 4-{{[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate

- To a solution of 1-(3,4-dichlorobenzyl)-4-piperidinamine hydrochloride (3.50g) in
 10 dichloromethane (100ml) was added methyl 4-chloro-4-oxobutanoate (2.00g) dropwise.
 Triethylamine (3.90g) was added and the reaction stirred under nitrogen for 2 hours.
 Saturated sodium hydrogen carbonate solution was then added, with the solution being
 extracted three times with dichloromethane. The pooled organic phase was washed once
 with water, once with saturated brine and dried over anhydrous magnesium sulfate. After
 15 filtration the solvent was removed under reduced pressure to leave methyl 4-{{[1-(3,4-
 dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate (3.00g).

MS (+veES) 373 ((M+H)⁺)

Step ii: Lithium 4-{{[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate

- To a solution of methyl 4-{{[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate
 20 (3.72g) in methanol (30ml) was added lithium hydroxide (0.41g) in water (10ml) which
 was stirred under nitrogen for 48 hours. The solvent was removed under reduced pressure,
 the residue was triturated with ether and filtered to leave lithium 4-{{[1-(3,4-
 dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate (3.50g).

MS (+veES) 359 ((M+H)⁺)

- 25 Step iii: 3-[3-(4-Bromo-1-methyl-1*H*-pyrazol-3-yl)-1,2,4-oxadiazol-5-yl]-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]propanamide

To lithium 4-{{[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino}-4-oxobutanoate (0.292g) in
 dichloromethane (6ml) was added dimethylformamide (1.5ml), 1-(3-

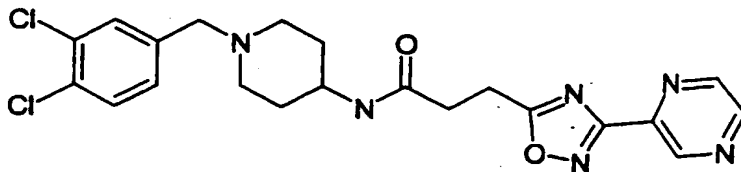
dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (0.183g), 1-hydroxybenzotriazole hydrate (0.130g), 4-bromo-*N*-hydroxy-1-methyl-1*H*-pyrazole-3-carboximidamide (0.175g) and triethylamine (0.161g). Reaction was left to stir for 24 hours before removal of dichloromethane under reduced pressure. Pyridine (5ml) was added and heated at reflux for 5 hours. Pyridine was removed under reduced pressure, followed by the addition of water. The solution was extracted three times with dichloromethane. The pooled organic phase was washed once with water, once with saturated brine and dried over magnesium sulfate. After filtration the product was azeotroped twice with toluene and was purified by reverse phase hplc (RPHPLC; 75%-5%, 0.1% ammonium acetate/ acetonitrile). Solvent was removed under reduced pressure to give the titled compound (0.164g).

MS (+veAPC) 543 ((M+H)⁺)

¹H NMR (DMSO): δ 8.21-8.17(1H,m); 7.95-7.76(1H,m); 7.60-7.54(1H,m); 7.35-7.25(1H,m); 4.35-4.21(1H,m); 3.93(2H,s); 3.44-3.35(2H,m); 3.19-3.14(3H,m); 2.73-2.64(2H,m); 2.58(3H,s); 2.00-1.89(2H,m); 1.73-1.60(2H,m); 1.36-1.24(1H,m).

Example 352

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-[3-(2-pyrazinyl)-1,2,4-oxadiazol-5-yl]propanamide



20

To lithium 4-[[1-(3,4-dichlorobenzyl)-4-piperidiny]amino]-4-oxobutanoate (Example 351, step ii) (0.292g) in dichloromethane (6ml) was added *N,N*-dimethylformamide (1.5ml), 1-(3-dimethylaminopropyl)-3-ethylcarbodiimide hydrochloride (0.183g), 1-hydroxybenzotriazole hydrate (0.130g), *N*-hydroxy-2-pyrazinecarboximidamide (0.110g) and triethylamine (0.161g). The reaction mixture was left to stir for 24 hours before removal of dichloromethane under reduced pressure. Pyridine (5ml) was added and heated at reflux for 5 hours. Pyridine was removed under reduced pressure followed by the addition of water. The solution was extracted three times with dichloromethane. The pooled organic phase was washed once with water, once with saturated brine and dried

25

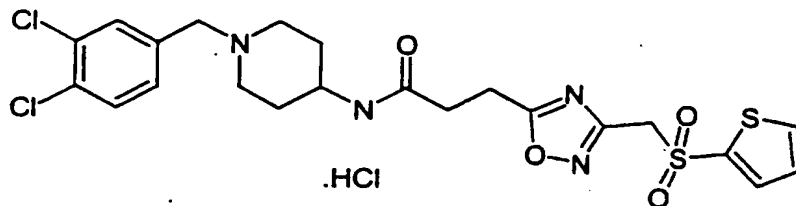
over magnesium sulfate. After filtration the product was azeotroped twice with toluene and was purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile). Solvent was removed under reduced pressure to give the title compound (0.067g).

MS (+veAPC) 461 ((M+H)⁺)

5 ¹H NMR (DMSO) δ 9.23(1H,s); 8.81-8.45(2H,m); 7.96-7.94(1H,m); 7.58-7.56(1H,m); 7.53-7.52(1H,m); 7.29-7.26(1H,m); 3.55-3.48(1H,m); 3.43(2H,s); 3.24-3.20(2H,m); 2.71-2.68(4H,m); 2.03-1.98(2H,m); 1.70-1.68(2H,m); 1.42-1.33(2H,m).

Example 353

10 *N*-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-{3-[(2-thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanamide hydrochloride



Step i: 3-{3-[(2-Thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanoic acid (1*Z*)-*N*'-hydroxy-2-(2-thienylsulfonyl)ethanimidamide (0.250g) with dihydro-2,5-furandione (0.114g) in dimethylformamide (0.2ml) was heated at 120°C for 2 hours. The reaction was allowed to cool and triturated with diethyl ether and filtered to leave 3-{3-[(2-thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanoic acid (0.332g).

MS (+veES) 303 ((M+H)⁺).

Step ii: *N*-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-{3-[(2-thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanamide hydrochloride

20 3-{3-[(2-Thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanoic acid (0.332g) in dichloromethane was stirred under nitrogen. Oxalyl chloride (0.252g) was added dropwise followed by the addition of one drop of dimethylformamide. After 30 minutes the solvent and oxalyl chloride was removed under reduced pressure followed by the addition of dichloromethane (10ml), 1-(3,4-dichlorobenzyl)-4-piperidinamine hydrochloride (0.347g), and triethylamine (0.202g) and allowed to stir for 2 hours under nitrogen. Saturated sodium hydrogen carbonate was added to the reaction with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once

with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to leave a brown oil. This oil was purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile) followed by chromatography using 3% ethanol/ dichloromethane. The solvent was removed under reduced pressure, followed by the addition of hydrogen chloride in diethyl ether, filtered and dried to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-{3-[(2-thienylsulfonyl)methyl]-1,2,4-oxadiazol-5-yl}propanamide hydrochloride (0.04g) as a pale yellow solid.

MS (+veES) 545 ((M+H)⁺)

¹H NMR (DMSO) δ 10.51(1H,s); 8.21-8.13(2H,m); 7.91(1H,s); 7.77-7.71(2H,m); 7.58-7.55(1H,m); 7.28-7.26(1H,m); 5.07-5.05(2H,m); 4.26-4.25(2H,m); 3.92(1H,m); 3.34-3.31(2H,m); 3.15-3.08(2H,m); 3.02-2.94(2H,m); 2.60-2.58(2H,m); 1.92-1.84(2H,m); 1.80-1.70(2H,m).

Example 354

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-[3-(4-pyridiny)-1,2,4-oxadiazol-5-yl]propanamide

Step i: 3-[3-(4-Pyridiny)-1,2,4-oxadiazol-5-yl]propanoic acid

N-hydroxy-4-pyridinecarboximidamide (0.300g) with dihydro-2,5-furandione (0.217g) in dimethylformamide (2 drops) was heated for 4 times 30 seconds in a CEM MARS 5 microwave at 100% of 300W to leave a fused mass. The reaction was allowed to cool and triturated with ethanol and filtered to leave 3-[3-(4-pyridiny)-1,2,4-oxadiazol-5-yl]propanoic acid (0.241g).

MS (+veES) 220 ((M+H)⁺)

Step ii: *N*-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-[3-(4-pyridiny)-1,2,4-oxadiazol-5-yl]propanamide

For method refer to Example 353 step ii.

Purification was performed via chromatography (2.5% ethanol/ dichloromethane). Solvent removed under reduced pressure to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-[3-(4-pyridiny)-1,2,4-oxadiazol-5-yl]propanamide (0.154g) as a pale cream solid.

MS (+veES) 460 ((M+H)⁺)

¹H NMR (DMSO) δ 8.81-8.79(2H,m); 7.96-7.90(3H,m); 7.60-7.56(2H,m); 7.30-7.27(1H,m); 3.53-3.51(1H,m); 3.44(2H,s); 3.23-3.19(2H,m); 2.71-2.68(4H,m); 2.05-1.97(2H,m); 1.71-1.67(2H,m); 1.44-1.32(2H,m).

5 Example 355

Cis-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]cyclopropanecarboxamide

Step i: Cis-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]cyclopropanecarboxylic acid
N-hydroxy-2-pyridinecarboximidamide (0.137g) with 3-oxabicyclo[3.1.0]hexane-2,4-
10 dione (0.112g) in dimethylformamide (2 drops) was heated for 4 times 30 seconds in a
CEM MARS 5 microwave at 100% of 300W to leave a fused mass. The reaction was
allowed to cool and triturated with diethyl ether and filtered to leave cis-2-[3-(2-pyridinyl)-
1,2,4-oxadiazol-5-yl]cyclopropanecarboxylic acid (0.200g).

MS (+veES) 232 ((M+H)⁺)

15 Step ii: Cis-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]cyclopropanecarboxamide

Cis-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]cyclopropanecarboxylic acid (0.139g) and
N,N'-carbonyldiimidazole (0.110g) in dichloromethane was stirred under nitrogen for 1
hour. 1-(3,4-dichlorobenzyl)-4-piperidinamine hydrochloride (0.198g), and triethylamine
20 (0.121g) was then added and allowed to stir for 24 hours under nitrogen. Saturated sodium
hydrogen carbonate was added to the reaction with the resulting solution being extracted
three times with dichloromethane. The pooled organic phases were washed once with
water, once with brine, dried over magnesium sulfate, filtered and the solvent removed
under reduced pressure to leave an oil. This oil was purified by RPHPLC (75%-5%, 0.1%
25 ammonium acetate/ acetonitrile). The solvent was removed under reduced pressure to
leave Cis-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]cyclopropanecarboxamide (0.054g) as a white solid.

MS (+veES) 472 ((M+H)⁺)

¹H NMR (DMSO) δ 8.74-8.73(1H,m); 8.26-8.24(1H,m); 8.03-7.98(2H,m); 7.59-
30 7.55(2H,m); 7.51(1H,s); 7.27-7.25(1H,m); 3.44-3.37(3H,m); 2.67-2.63(3H,m); 2.27-
2.21(1H,m); 2.00-1.89(2H,m); 1.66-1.65(2H,m); 1.59-1.56(1H,m); 1.48-1.43(1H,m); 1.37-
1.32(2H,m).

Example 356

N-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-[3-(2-pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanamide

5 Step i: 3-[3-(2-Pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanoic acid

2-Pyridinecarbohydrazonamide (0.136g) and dihydro-2,5-furandione (0.100g) in 1 ml of dimethylacetamide was heated for 10 times 30 seconds in a CEM MARS 5 microwave at 100% of 300W under nitrogen to leave 3-[3-(2-pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanoic acid in 1ml of dimethylacetamide.

10 MS (-veES) 217 ((M-H)⁺)

Step ii: *N*-[1-(3,4-Dichlorobenzyl)-4-piperidiny]-3-[3-(2-pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanamide

3-[3-(2-Pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanoic acid (0.218g in 1ml dimethylacetamide) and *N,N'*-carbonyldiimidazole (0.250g) in dichloromethane was stirred under nitrogen for
 15 30 minutes. 1-(3,4-Dichlorobenzyl)-4-piperidinamine hydrochloride (0.316g), and triethylamine (0.218g) was then added and allowed to stir for 2 hours under nitrogen. 1M sodium hydroxide was added to the reaction with the resulting solution being washed three times with dichloromethane. The aqueous phase was acidified with glacial acetic acid, with the water/ acetic acid being removed under reduced pressure. Water was then added
 20 and extracted three times with dichloromethane. The pooled organic phases were extracted once with water and the water removed under reduced pressure to leave a white solid. This was then triturated with diethyl ether/ dichloromethane, filtered and was purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile), solvent removed to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-[3-(2-pyridinyl)-1*H*-1,2,4-triazol-5-yl]propanamide
 25 (0.02g).

MS (+veES) 459 ((M+H)⁺)

¹H NMR (DMSO) δ 8.66-8.65(1H,m); 8.03-8.01(1H,m); 7.95-7.91(1H,m); 7.83-7.81(1H,m); 7.58-7.56(1H,m); 7.52(1H,m); 7.47-7.44(1H,m); 7.29-7.27(1H,m); 3.55-3.50(1H,m); 3.43(2H,s); 2.93-2.89(2H,m); 2.68-2.67(2H,m); 2.55-2.49(2H,m); 2.04-
 30 1.98(2H,m); 1.70-1.68(2H,m); 1.42-1.32(2H,m).

Example 357

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(3-phenyl-1*H*-1,2,4-triazol-5-yl)acetamide (3-Phenyl-1*H*-1,2,4-triazol-5-yl)acetic acid (0.020g) and *N,N'*-carbonyl diimidazole (0.016g) in dichloromethane was stirred under nitrogen for 30 minutes. 1-(3,4-Dichlorobenzyl)-4-piperidinamine hydrochloride (0.031g) and triethylamine (0.036g) was then added and allowed to stir for 1 hour under nitrogen. Saturated sodium hydrogen carbonate was added to the reaction with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to a white solid. This was purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile). Saturated sodium hydrogen carbonate was added to the pooled collected fractions with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(3-phenyl-1*H*-1,2,4-triazol-5-yl)acetamide(0.031g).

MS (+veES) 444 ((M+H)⁺)

¹H NMR (DMSO) δ 8.18-8.15(1H,m); 7.98-7.95(2H,m); 7.59-7.54(2H,m); 7.49-7.41(3H,m); 7.31-7.29(1H,m); 3.63(2H,s); 3.57-3.47(1H,m); 3.45(2H,s); 2.74-2.70(2H,m); 2.08-2.01(2H,m); 1.77-1.74(2H,m); 1.48-1.38(2H,m).

Example 358

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-(5-phenyl-1,3,4-oxadiazol-2-yl)acetamide acetate
3-(5-Phenyl-1,3,4-oxadiazol-2-yl)propanoic acid (0.175g) and *N,N'*-carbonyldiimidazole (0.148g) in dichloromethane was stirred under nitrogen for 30 minutes. 1-(3,4-Dichlorobenzyl)-4-piperidinamine hydrochloride (0.263g), and triethylamine (0.126g) was then added and allowed to stir for 2 hours under nitrogen. Saturated sodium hydrogen carbonate was added to the reaction, with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to leave a cream solid. This solid was purified by chromatography using 2.5% ethanol/ dichloromethane. The solvent was removed under reduced pressure and was

purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile), followed by 1 ml of glacial acetic acid being added and the solvent removed under reduced pressure to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(5-phenyl-1,3,4-oxadiazol-2-yl)acetamide acetate (0.024g).

5 MS (+veES) 445 ((M+H)⁺)

¹H NMR (DMSO) δ 8.31-8.29(1H,m); 7.98-7.96(2H,m); 7.66-7.54(5H,m); 7.31-7.29(1H,m); 3.92(2H,s); 3.57-3.56(1H,m); 3.46(2H,s); 2.74-2.71(2H,m); 2.07-2.02(2H,m); 1.78-1.75(2H,m); 1.47-1.39(2H,m).

10 Example 359

N-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]acetamide

Step i: Lithium [3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]acetate

2-(5-Methyl-1,2,4-oxadiazol-3-yl)pyridine (0.150g) was stirred at -78°C in dry
15 tetrahydrofuran under nitrogen. (1.6M) *n*-butyl lithium (0.757ml) was added dropwise so as to maintain the temperature at -78°C. After 30 minutes carbon dioxide was passed through the solution and the reaction was allowed to return to room temperature. Once the reaction had reached room temperature, water (1ml) was added and all solvents were removed under reduced pressure to leave a yellow solid. This solid was triturated with
20 ethyl acetate and filtered to leave a pale yellow solid (0.150g).

¹H NMR (DMSO+D₂O) δ 8.75-8.73(1H,m); 8.12-8.00(2H,m); 7.65-7.61(1H,m); 3.77(2H,s).

Step ii: *N*-[1-(3,4-Dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]acetamide

25 Lithium [3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]acetate (0.140g), 1-(3,4-dichlorobenzyl)-4-piperidinamine (0.170g), PyBroP™ (0.400g) were stirred under nitrogen in dimethylformamide (15ml). *N,N*-Diisopropylethylamine (0.171g) was added and left to stir for 2 hours. 1M sodium hydroxide was added to the reaction, with the resulting solution being extracted three times with dichloromethane. The pooled organic phases
30 were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to leave product plus dimethylformamide. Water was added which resulted in precipitation of the product. The product was filtered

and was purified by RPHPLC (75%-5%, 0.1% ammonium acetate/ acetonitrile). After removal of the solvent under reduced pressure the resulting white solid was triturated with diethyl ether, filtered and dried to leave *N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]acetamide (0.067g).

m.p. 145°C

MS (+veES) 446 ((M+H)⁺)

¹H NMR (DMSO) δ 8.77-8.75(1H,m); 8.37-8.35(1H,m); 8.07-8.00(2H,m); 7.62-7.54(3H,m); 7.31-7.30(1H,m); 4.02(2H,s); 3.60-3.55(1H,m); 3.46(2H,s); 2.74-2.67(2H,m); 2.08-2.03(2H,m); 1.78-1.76(2H,m); 1.48-1.39(2H,m).

Example 360

N-[1-(4-Bromobenzyl)-4-piperidinyl]-2-(4-fluorophenyl)acetamide

2-(4-Fluorophenyl)-*N*-(4-piperidinyl)acetamide (WO97/36871; 1.00g), 1-bromo-4-(bromomethyl)benzene (1.06g) and potassium carbonate (0.877g) in dimethylformamide (15ml) were heated to 70°C, under nitrogen for 1 hour. Water was added to the reaction, with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure to leave a cream solid.

This solid was triturated with diethyl ether, filtered and recrystallised from ethanol/ water to give white crystalline needles of *N*-[1-(4-bromobenzyl)-4-piperidinyl]-2-(4-fluorophenyl)acetamide.

m.p. 144°C

MS (+veES) 407 ((M+H)⁺)

¹H NMR (DMSO) δ 7.99-7.98(1H,m); 7.51-7.49(2H,m); 7.28-7.24(4H,m); 7.12-7.06(2H,m); 3.51-3.46(1H,m); 3.41(2H,s); 3.36(2H,s); 2.72-2.69(2H,m); 2.01-1.96(2H,m); 1.70-1.68(2H,m); 1.42-1.34(2H,m).

Example 361

2-(4-Fluorophenyl)-*N*-[1-(2-quinolinylmethyl)-4-piperidinyl]acetamide

2-(4-Fluorophenyl)-*N*-(4-piperidinyl)acetamide (WO97/36871; 0.05g), 2-quinolinecarbaldehyde (0.033g) and sodium triacetoxyborohydride (0.067g) in dichloroethane (3ml) were stirred under nitrogen for 24 hours. Saturated sodium hydrogen

carbonate was added to the reaction, with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure, triturated with diethyl ether/ ethyl acetate and filtered to leave 2-(4-fluorophenyl)-*N*-[1-(2-quinolinylmethyl)-4-piperidinyl]acetamide (0.020g).

MS (+veES) 378 ((M+H)⁺)

¹H NMR (DMSO) δ 8.34-8.31(1H,m); 8.02-7.94(3H,m); 7.75-7.71(1H,m); 7.63-7.55(2H,m); 7.28-7.25(2H,m); 7.13-7.08(2H,m); 3.74(2H,s); 3.57-3.50(1H,m); 3.30(2H,s); 2.79-2.76(2H,m); 2.16-2.11(2H,m); 1.73-1.70(2H,m); 1.48-1.39(2H,m).

Example 362

N-[1-(3-Chloro-4-fluorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide

3-[3-(2-Pyridinyl)-1,2,4-oxadiazol-5-yl]propanoic acid (0.218g) and *N,N'*-

carbonyldiimidazole (0.194g) were stirred in dichloromethane (10ml) under nitrogen for 1 hour. 1-(3-Chloro-4-fluorobenzyl)-4-piperidinamine (JP 59101483; 0.242g) was then added and left to stir for 24 hours. Saturated sodium hydrogen carbonate was added to the reaction, with the resulting solution being extracted three times with dichloromethane. The pooled organic phases were washed once with water, once with brine, dried over magnesium sulfate, filtered and the solvent removed under reduced pressure, triturated with ethyl acetate/ ethanol and filtered to leave *N*-[1-(3-chloro-4-fluorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide.

m.p. 150°C

MS (+veAPC) 444 ((M+H)⁺)

¹H NMR (DMSO) δ 8.75-8.74(1H,m); 8.05-7.99(2H,m); 7.95-7.93(1H,m); 7.61-7.58(1H,m); 7.48-7.45(1H,m); 7.37-7.30(1H,m); 7.30-7.26(1H,m); 3.53-3.51(1H,m); 3.42(2H,s); 3.21-3.17(2H,m); 2.71-2.66(4H,m); 2.02-1.96(2H,m); 1.70-1.67(2H,m); 1.42-1.33(2H,m).

Example 363

N-[1-(4-Chloro-3-fluorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-oxadiazol-5-yl]propanamide

Step i: *tert*-Butyl 1-(4-chloro-3-fluorobenzyl)-4-piperidinylcarbamate
4-Chloro-3-fluorobenzaldehyde (0.793g) and *tert*-butyl 4-piperidinylcarbamate (1.00g)
were stirred under nitrogen in dried tetrahydrofuran (25ml). Sodium
triacetoxyborohydride (1.266g) was then added and left for 24 hours. Saturated sodium
5 hydrogen carbonate was added to the reaction, with the resulting solution being extracted
three times with dichloromethane. The pooled organic phases were washed once with
water, once with brine, dried over magnesium sulfate, filtered and the solvent removed
under reduced pressure to leave *tert*-butyl 1-(4-chloro-3-fluorobenzyl)-4-
piperidinylcarbamate (1.80g) as a white solid.

10 MS (+veAPC) 343 ((M+H)⁺)

Step ii: 1-(4-Chloro-3-fluorobenzyl)-4-piperidinamine
tert-Butyl 1-(4-chloro-3-fluorobenzyl)-4-piperidinylcarbamate (1.80g) in dichloromethane
(20ml) was stirred under nitrogen. Trifluoroacetic acid (5ml) was then added dropwise and
the reaction was left to stir for 2 hours. 1M sodium hydroxide was added to the reaction
15 until basic, with the resulting solution being extracted three times with dichloromethane.
The pooled organic phases were washed once with water, once with brine, dried over
magnesium sulfate, filtered and the solvent removed under reduced pressure. Product
purified by chromatography (5% ethanol/ dichloromethane to 10% ethanol/
dichloromethane) and solvent removed under reduced pressure to leave an oil which
20 crystallised over the period of 48 hours. The resulting solid was triturated with diethyl
ether and filtered to leave 1-(4-chloro-3-fluorobenzyl)-4-piperidinamine (0.500g) as a
white solid.

Step iii: N-[1-(4-Chloro-3-fluorobenzyl)-4-piperidinyl]-3-[3-(2-pyridinyl)-1,2,4-
oxadiazol-5-yl]propanamide

25 3-[3-(2-Pyridinyl)-1,2,4-oxadiazol-5-yl]propanoic acid (0.136g) and N,N'-
carbonyldiimidazole (0.114g) were stirred in dichloromethane (10ml) under nitrogen for 1
hour. 1-(4-Chloro-3-fluorobenzyl)-4-piperidinamine (0.150g) was then added and left to
stir for 2 hours. Saturated sodium hydrogen carbonate was added to the reaction, with the
resulting solution being extracted three times with dichloromethane. The pooled organic
30 phases were washed once with water, once with brine, dried over magnesium sulfate,
filtered and the solvent removed under reduced pressure to leave an oil. This was triturated
with diethyl ether which caused product to crystallise. After filtration, the product was

washed with diethyl ether and dried to N-[1-(4-chloro-3-fluorobenzyl)-4-piperidiny]-3-[3-(2-pyridiny)-1,2,4-oxadiazol-5-yl]propanamide.

m.p. 132°C

MS (+veES) 444 ((M+H)⁺)

5 ¹H NMR (DMSO) δ 8.76-8.74(1H,m); 8.05-7.99(2H,m); 7.95-7.94(1H,m); 7.61-7.58(1H,m); 7.54-7.50(1H,m); 7.32-7.28(1H,m); 7.16-7.14(1H,m); 3.55-3.47(1H,m); 3.44(2H,s); 3.21-3.17(2H,m); 2.71-2.66(4H,m); 2.03-1.97(2H,m); 1.70-1.67(2H,m); 1.42-1.33(2H,m).

10 Example 364

2-(4-Chlorophenoxy)-N-[1-[(3,4-dichlorophenyl)methyl]-piperidin-4-yl]-acetamide

The product from Example 1 step (ii) was dissolved in dichloromethane (10ml) containing triethylamine (0.081g) and the solution was cooled to 0°C. 4-Chlorophenoxyacetyl chloride (88mg) in dichloromethane (3ml) was added dropwise, the cooling bath was
15 removed and the resulting solution was stirred for 1 hour. Ethyl acetate, water and brine were added and the phases were separated. The organic phase was dried, filtered and evaporated to give an oil which was purified by reverse phase HPLC (with a gradient eluent system (25% MeCN/NH₄OAc_{aq} (0.1%) to 95% MeCN/NH₄OAc_{aq} (0.1%)) to give the title compound (0.049g).

20 ¹H NMR: (CDCl₃): δ 1.51 (2H, ddd), 1.89 - 1.96 (2H, m), 2.15 (2H, td), 2.77 (2H, d), 3.43 (2H, s), 3.85 - 3.96 (1H, m), 4.44 (2H, s), 6.37 (1H, d), 6.85 (2H, dt), 7.14 (1H, dd), 7.26 - 7.29 (2H, m), 7.37 (1H, d), 7.43 (1H, d)

Example 365

25 N-(1-benzyl-4-piperidiny)-3-[3-(2-pyridiny)-1,2,4-oxadiazol-5-yl]propanamide

To a solution of 3-(3-Pyridin-2-yl-[1,2,4]oxadiazol-5-yl)-propionic acid (1g) in tetrahydrofuran (5ml), was added carbonyldiimidazole (0.74g). The mixture was stirred for 10 minutes before addition of 1-benzyl-piperidin-4-ylamine (1ml) in tetrahydrofuran (5ml). The reaction mixture was stirred for 15 minutes then partitioned between ethyl
30 acetate (20ml) and water (20ml). The organic layer was separated, dried (MgSO₄) and solvent removed by evaporation. Purification by Biotage® 40S eluting 3%MeOH/0.5% 880 ammonia/dichloromethane gave the title compound (0.93g).

MS: ESI 392 (+H)

¹H NMR: (CDCl₃): δ 1.44 (2H, ddd), 1.88 (2H, d), 2.10 (2H, t), 2.73 - 2.78 (2H, m), 2.80 (2H, t), 3.33 (2H, t), 3.46 (2H, s), 3.75 - 3.86 (1H, m), 5.57 (1H, d), 7.23 - 7.32 (5H, m), 7.42 (1H, ddt), 7.84 (1H, tt), 8.10 (1H, dd), 8.79 (1H, td).

5

Example 366

N-(2-[[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-methyl-amino]-ethyl)-2-(2-fluoro-phenyl)-acetamide

Step i: (2-Methylamino-ethyl)-carbamic acid tert-butyl ester

10 To a solution of (2-amino-ethyl)-carbamic acid-*tert*-butyl ester (5g) and triethylamine (6.5ml) in tetrahydrofuran (1000ml) at 0°C was added methyl iodide (1.94ml) dropwise over a period of 1 hour. The mixture was allowed to warm to ambient temperature and stirred for 72 hours before removal of solvents by evaporation. The residue was partitioned between ethyl acetate and water. The organic layer was separated, dried
15 (MgSO₄) and solvent removed by evaporation to give the title compound (3.7g).

MS: ESI 57((CH₃)₄C+), 118 (M+H - (CH₃)₄C)

Step ii: (2-[[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-methyl-amino]-ethyl)-carbamic acid *tert*-butyl ester

20 To a solution of dichlorobenzyl- piperidin-4-one (Example 74, step (i), 4.8g) and acetic acid (1ml) in dichloromethane (100ml) was added (2-methylamino-ethyl)-carbamic acid *tert*-butyl ester (3.26g) and the mixture was stirred for 5 minutes before addition of sodium triacetoxyborohydride (7.9g). The reaction mixture was stirred for 12 hours before addition of sodium bicarbonate solution. The mixture was stirred for ½ hour and then partitioned between water and dichloromethane. The organic layer was separated, dried
25 (MgSO₄) and solvent removed by evaporation. Purification by Biotage® 40S eluting 10%MeOH/2% triethylamine/dichloromethane gave the title compound (1.7g).

MS: ESI 316/318 (+H - (CH₃)₄COCO)

¹H NMR: (CDCl₃): δ 1.44 (9H, s), 1.50 - 1.60 (4H, m), 1.65 - 1.72 (2H, m), 1.95 (2H, td), 2.23 (3H, s), 2.34 (1H, tt), 2.88 (2H, d), 3.14 - 3.20 (2H, m), 3.41 (2H, s), 4.95 - 5.01 (1H,
30 m), 7.13 - 7.15 (1H, m), 7.37 (1H, d), 7.42 (1H, d).

Step iii: *N*¹-[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-*N*¹-methyl-ethane-1,2-diamine

(2-{{[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-methyl-amino}-ethyl)-carbamic acid *tert*-butyl ester (1.7g) was dissolved in 6M HCl (20ml) and stirred for 12 hours. The solvent was evaporated and the residue was azeotroped with toluene and then sodium bicarbonate solution was added. The mixture was stirred for 10 minutes and the product was extracted
 5 with dichloromethane. The solvent was removed by evaporation to give the title compound (0.75g).

MS: ESI 316/318 (+H)

Step iv: *N*-(2-{{[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-methyl-amino}-ethyl)-2-(2-fluorophenyl)-acetamide

10 Prepared by the method of Example 359 step (ii) using *N*¹-[1-(3,4-Dichloro-benzyl)-piperidin-4-yl]-*N*¹-methyl-ethane-1,2-diamine and 2-fluorophenylacetic acid.

MS: ESI 452/454 (+H)

¹H NMR: (CDCl₃): δ 2.08 – 1.94 (2H, m), 2.37 – 2.33 (2H, m), 2.95 (3H, s), 3.18 (2H, t), 3.41 (2H, m), 3.66 – 3.78 (4H, m), 3.75 (2H, s), 3.84 (1H, m), 4.38 (2H, s), 7.16 – 7.28 (2H,
 15 m), 7.36 – 7.42 (2H, m), 7.45 (1H, dd), 7.73 (1H, d), 7.72 (1H, d).

Example 367

N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-*N*-methyl-2-(4-fluorophenyl)acetamide

Step i: [1-(3,4-Dichlorobenzyl)-piperidin-4-yl]-methyl-amine

20 To a solution of 1-(3,4-Dichloro-benzyl)-piperidin-4-one (3.1g) in dichloromethane (50ml) and acetic acid (0.69ml) was added methylamine (6ml of a 1M solution in tetrahydrofuran). The mixture was stirred for 5 minutes before the addition of sodium triacetoxyborohydride (3g) and the resulting mixture stirred for 72 hours. Sodium bicarbonate solution (100ml) added and the mixture stirred vigorously for 5 minutes before
 25 extraction of the product with dichloromethane (2X200ml). The organics were separated, bulked and dried, (MgSO₄). Purification by Biotage[®] 40S eluting 10%MeOH/0.5% 880 ammonia/dichloromethane gave the sub-title compound (1.8g).

MS: ESI 273/275 (+H)

¹H NMR: (CDCl₃): δ 1.36 (2H, qd), 1.82 - 1.91 (2H, m), 2.03 (2H, td), 2.36 (1H, tt), 2.43
 30 (3H, s), 2.76 - 2.83 (2H, m), 3.43 (2H, s), 7.15 (1H, dd), 7.37 (1H, d), 7.42 (1H, d).

Step ii: *N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(4-fluorophenyl)acetamide

To a solution of 4-fluorophenylacetic acid (100mg) in tetrahydrofuran (3ml) was added carbonyldiimidazole (105mg). The mixture was stirred for 10 minutes before addition of [1-(3,4-dichlorobenzyl)-piperidin-4-yl]-methyl-amine (177mg) in tetrahydrofuran (2ml). Stirring was continued for 1 hour then solvent removed by evaporation. Purification by Biotage® 40S eluting 2%MeOH/0.5% 880 ammonia/dichloromethane gave the title compound (166mg).

MS: ESI 273/275 (M+H)

¹H NMR: (CDCl₃) δ 1.57 (1H, d), 1.69 (1H, qd), 1.76 - 1.84 (1H, m), 1.88 (1H, q), 2.10 (2H, td), 2.85 - 2.90 (1H, m), 2.85 (3H, s), 3.42 (2H, s), 3.58 (1H, tt), 3.67 (2H, s), 4.51 (1H, tt), 7.00 (2H, t), 7.11 - 7.15 (1H, m), 7.18 - 7.23 (2H, m), 7.37 (1H, d), 7.41 (1H, dd).

Example 368

N-[1-[(3,4-dichlorophenyl)methyl]-4-piperidinyl]-2-(2-pyrimidinyloxy)-acetamide

Step i: Ethyl 2-pyrimidinyloxyacetate

Ethyl glycolate (1.04g) was dissolved in tetrahydrofuran (10ml) and the solution was cooled to 0°C. Sodium hydride (60% suspension in oil, 0.43g) was added and the suspension was stirred and then sonicated in an ultrasonic bath. 2-Chloropyrimidine (1.14g) was added and the mixture was sonicated for a further 110min. Ammonium chloride solution was added and the mixture was extracted thrice with ethyl acetate, the organic phases were washed with brine and dried, filtered and evaporated. The residue was purified by chromatography eluting with *iso*-hexane: ethyl acetate (13:7) to give the subtitle compound (1.40g) as an oil.

¹H NMR (299.944 MHz, CDCl₃) δ 1.26 (t, *J* = 6.8 Hz, 3H), 4.24 (q, *J* = 7.1 Hz, 2H), 4.93 (s, 2H), 6.98 (t, *J* = 4.8 Hz, 1H), 8.53 (d, *J* = 4.8 Hz, 2H).

Step ii: 2-Pyrimidinyloxyacetic acid

Ethyl 2-pyrimidinyloxyacetate (1.4g) was dissolved in ethanol (10ml). Sodium hydroxide (2M aq) was added and the mixture was stirred for 64h. The solvent was evaporated and the residue was dissolved in water, filtered and acidified with concentrated hydrochloric acid. The resulting precipitate was collected and dried to give the subtitle compound (0.698g).

¹H NMR (399.98 MHz, DMSO) δ 4.85 (s, 2H), 7.09 (t, *J* = 4.9 Hz, 1H), 8.56 (d, *J* = 4.8 Hz, 2H).

Step iii: *N*-[1-[(3,4-dichlorophenyl)methyl]-4-piperidinyl]-2-(2-pyrimidinylloxy)-acetamide

The title compound was prepared from the product of Example 1 step (ii) (hydrochloride salt, 335mg) and 2-pyrimidinylloxyacetic acid (170mg) using the method of Example 94.

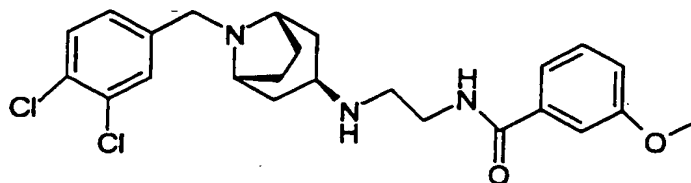
5 Yield 140mg.

m.p. 120-122°C

¹H NMR (399.978 MHz, CDCl₃) δ 1.50 (q, J = 11.6 Hz, 2H), 1.91 (d, J = 11.9 Hz, 2H), 2.13 (t, J = 11.1 Hz, 2H), 2.77 (d, J = 11.4 Hz, 2H), 3.42 (s, 2H), 3.86 - 3.95 (m, 1H), 4.87 (s, 2H), 6.49 (d, J = 6.9 Hz, 1H), 7.05 (t, J = 4.9 Hz, 1H), 7.14 (m, 1H), 7.37 (d, J = 8.3 Hz, 1H), 7.42 (s, 1H), 8.57 (d, J = 4.8 Hz, 2H).

Example 369

N-[2-[[8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]amino]ethyl]-3-methoxy-benzamide, bis toluene sulfonic acid salt



15.

Step i: 8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-one

2,5-Dimethoxytetrahydrofuran (4.92g) was stirred in hydrochloric acid (1M, 25 ml) for 1 hour. 3,4-Dichlorobenzylamine (5ml) was added to hydrochloric acid (1M, 15ml) and the resulting suspension was added to the first solution. Phosphate buffer solution (pH 5.5, 250ml) was added followed by sodium hydroxide (1.6g). A solution of acetone dicarboxylic acid (4.77g) in phosphate buffer solution (pH 5.5, 90ml) was added to the mixture and the solution was stirred. A yellow solid formed and the mixture was left to stand for 64h. The aqueous supernatant was decanted and hydrochloric acid (2.5M) was added to the solid along with ethyl acetate. The layers were separated and the aqueous phase was extracted twice with dichloromethane containing a little methanol. The organic layers were combined and evaporated to give a crude oil (ca 7g). A portion of the product (ca 2.5g) was purified by chromatography eluting with dichloromethane : methanol (19:1) to give the subtitle compound (1.62g) as a yellow oil.

25

¹H NMR (299.944 MHz, CDCl₃) δ 1.62 - 1.70 (m, 2H), 2.09 - 2.15 (m, 2H), 2.23 (d, *J* = 15.9 Hz, 2H), 2.67 (d, *J* = 16.7 Hz, 2H), 3.43 - 3.49 (m, 2H), 3.68 (s, 2H), 7.26 (d, *J* = 8.7 Hz, 1H), 7.41 (d, *J* = 7.5 Hz, 1H), 7.54 (s, 1H)

Step ii: Carbamic acid, Endo-[2-[[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]amino]ethyl]-1,1-dimethylethyl ester

8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-one (751 mg) and carbamic acid, (2-aminoethyl)-1,1-dimethylethyl ester (520 mg) were dissolved in dichloroethane (23ml). Sodium triacetoxyborohydride (697 mg) was added and the suspension was stirred at room temperature for 20 hours. Dichloromethane was added and the solution was washed with sodium bicarbonate solution, then with water and then with brine.

Chromatography of the residue eluting with ethyl acetate : methanol : triethylamine (80:19:1) gave the subtitle compound (688mg) as an oil.

¹H NMR (399.978 MHz, CDCl₃) δ 1.45 (s, 9H), 1.52 (d, *J* = 14.4 Hz, 2H), 1.96 - 2.09 (m, 6H), 2.67 (t, *J* = 5.8 Hz, 2H), 2.88 (t, *J* = 6.4 Hz, 1H), 3.08 - 3.12 (m, 2H), 3.21 (q, *J* = 5.7 Hz, 2H), 3.48 (s, 2H), 4.80 - 4.95 (m, 1H), 7.22 (dd, *J* = 8.3, 2.0 Hz, 1H), 7.37 (d, *J* = 7.9 Hz, 1H), 7.49 (d, *J* = 2.0 Hz, 1H)

Step iii: *N*-[2-[[8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]amino]ethyl]-3-methoxy-benzamide, bis toluene sulfonic acid salt

Carbamic acid, [2-[[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]amino]ethyl]-, 1,1-dimethylethyl ester (337mg) was dissolved in dichloromethane (3ml) and trifluoroacetic acid (3ml) was added. The resulting solution was stirred for 1 hour then the volatiles were evaporated. The residue was dissolved in dichloromethane (3ml) and triethylamine (1ml) was added followed by 3-methoxybenzoyl chloride (120μl). The solution was stirred overnight. The solvent was evaporated and the residue was purified by RPHPLC (gradient ammonium acetate 1% aqueous : acetonitrile (25% acetonitrile to 95% acetonitrile)). Excess tosic acid in ether was added to the residue and the resultant salt was recrystallised from a mixture of ethyl acetate - ethanol with a little cyclohexane to give the title compound (77mg).

m.p. 180-182.5°C

¹H NMR (399.98 MHz, DMSO) δ 2.10 - 2.24 (m, 4H), 2.29 (s, 6H), 2.39 - 2.47 (m, 4H), 3.21 - 3.28 (m, 2H), 3.52 - 3.57 (m, 1H), 3.57 - 3.63 (m, 2H), 3.80 (s, 3H), 3.85 - 3.91 (m, 2H), 4.21 (d, *J* = 5.4 Hz, 2H), 7.11 (d, *J* = 9.4 Hz, 4H), 7.13 - 7.18 (m, 1H), 7.38 - 7.45 (m,

3H), 7.48 (d, J = 7.9 Hz, 4H), 7.56 (d, J = 6.7 Hz, 1H), 7.78 (d, J = 8.2 Hz, 1H), 7.84 - 7.90 (m, 1H), 8.38 - 8.52 (m, 2H), 8.81 - 8.87 (m, 1H), 9.44 - 9.51 (m, 1H).

5 Example 370

Endo-*N*-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide hydrochloride

Step i: Endo-8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-amine

8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-one (350mg) was dissolved in
10 dry methanol (12ml) and ammonium acetate (1g) was added. The mixture was stirred to get partial solution and then sodium cyanoborohydride (106mg) was added. The mixture was heated under reflux for 150 minutes, then allowed to cool to room temperature. The methanol was evaporated, the residue was partitioned between sodium hydroxide and dichloromethane, and the aqueous phase was extracted twice with dichloromethane. The
15 organic phases were combined, dried, filtered and evaporated to give the subtitle compound.

$[M+H]^+$ (ES+) 285

Step ii: Endo-*N*-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide hydrochloride

20 3-(2-Pyridinyl)-1,2,4-oxadiazole-5-propanoic acid (305mg) was suspended in dichloromethane (6ml) and oxalyl chloride (0.5ml) was added. The mixture was stirred overnight. Toluene (1ml) was added to the solution, the volatiles were evaporated, then the residue was redissolved in dichloromethane (2ml). Endo-8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-amine (all from step(i)) was dissolved
25 in dichloromethane (4ml) containing triethylamine (0.5ml) and then cooled in an ice bath. The acid chloride solution was added to the amine and the mixture was stirred for 1 hour. Water was added to the reaction mixture and the phases were separated. The aqueous phase was extracted twice with dichloromethane, the organic phases were dried, filtered and evaporated. The residue was purified by RPHPLC (gradient ammonium acetate 1%
30 aqueous : acetonitrile (25% acetonitrile to 95% acetonitrile)). The product was suspended in ether and the ethereal hydrochloric acid was added, the suspension was stirred and then the diethyl ether was evaporated. The residue was dissolved in hot ethyl acetate containing

ethanol and crystallisation was induced by adding *iso*-hexane to give the title compound (47mg).

¹H NMR (399.98 MHz, DMSO) δ 1.99 - 1.90 (m, 2H), 2.41 - 2.20 (m, 6H), 2.77 (t, J = 6.8 Hz, 2H), 3.23 (t, J = 6.9 Hz, 2H), 3.81 - 3.72 (m, 3H), 4.15 (d, J = 6.2 Hz, 2H), 7.63 - 7.58 (m, 1H), 7.67 (dd, J = 7.6, 2.3 Hz, 2H), 7.76 (d, J = 9.3 Hz, 1H), 8.06 - 7.99 (m, 3H), 8.11 (d, J = 4.1 Hz, 1H), 8.75 (d, J = 4.6 Hz, 1H), 10.13 (t, J = 5.6 Hz, 1H).

Example 371

2-[4-(acetylamino)phenoxy]-N-[1-[(3,4-dichlorophenyl)methyl]-4-piperidinyl]-acetamide

Step i: Methyl (4-acetaminophenoxy)acetate

4-Acetaminophenol (1.51g), potassium carbonate (1.38g) and methyl bromoacetate (1.0ml) were combined in acetone (40ml) and heated to reflux for 5 hours. The mixture was allowed to cool to room temperature, filtered and evaporated. The residue was dissolved in ethyl acetate, washed with water and then with brine then dried, filtered and evaporated to give the subtitle compound (2.32g).

¹H NMR (399.978 MHz, CDCl₃) δ 2.16 (s, 3H), 3.80 (s, 3H), 4.62 (s, 2H), 6.87 (d, J = 9.1 Hz, 2H), 7.07 (br s, 1H), 7.40 (d, J = 9.0 Hz, 2H)

Step ii: (4-Acetaminophenoxy)acetic acid

Methyl (4-acetaminophenoxy)acetate was hydrolysed following the method of Example 368 step (ii) to give the subtitle compound (1.85g).

¹H NMR (399.98 MHz, DMSO) δ 2.00 (s, 3H), 4.61 (s, 2H), 6.84 (d, J = 9.0 Hz, 2H), 7.46 (d, J = 9.0 Hz, 2H), 9.80 (s, 1H).

Step iii: 2-[4-(acetylamino)phenoxy]-N-[1-[(3,4-dichlorophenyl)methyl]-4-piperidinyl]-acetamide

The title compound was prepared from the product of Example 1 step (ii) (free base, 281mg) and (4-acetaminophenoxy)acetic acid (229mg) using a method hereinbefore described (yield 40mg).

m.p. 177-178.5°C.

¹H NMR (299.946 MHz, DMSO) δ 1.51 (qd, J = 10.5, 3.7 Hz, 2H), 1.72 - 1.63 (m, 2H), 2.00 (s, 3H), 2.05 (t, J = 3.7 Hz, 2H), 2.77 - 2.68 (m, 2H), 3.45 (s, 2H), 3.70 - 3.57 (m, 1H), 4.39 (s, 2H), 6.88 (d, J = 9.0 Hz, 2H), 7.29 (dd, J = 8.1, 1.7 Hz, 1H), 7.47 (d, J = 8.8 Hz, 2H), 7.54 (d, J = 1.5 Hz, 1H), 7.58 (d, J = 8.1 Hz, 1H), 7.89 (d, J = 8.1 Hz, 1H), 9.79 (s, 1H).

Example 372

N-[1-[(3,4-dichlorophenyl)methyl]-4-piperidinyl]-4-hydroxy-benzeneacetamide

The title compound was prepared from the product of Example 1 step (ii) (free base, 172mg) and 4-hydroxyphenylacetic acid (135mg) using a method hereinbefore described (yield 57mg).

m.p. 72-97°C.

¹H NMR (399.98 MHz, DMSO) δ 1.37 (q, *J* = 7.0 Hz, 2H), 1.69 (d, *J* = 11.3 Hz, 2H), 2.02 (t, *J* = 5.3 Hz, 2H), 2.71 (d, *J* = 11.3 Hz, 2H), 3.23 (s, 2H), 3.44 (s, 2H), 3.55 - 3.42 (m, 1H), 6.66 (d, *J* = 8.5 Hz, 2H), 7.02 (d, *J* = 8.5 Hz, 2H), 7.29 (d, *J* = 8.2 Hz, 1H), 7.53 (s, 1H), 7.58 (d, *J* = 8.2 Hz, 1H), 7.87 (d, *J* = 7.9 Hz, 1H), 9.18 (s, 1H).

Example 373

Exo-*N*-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide

Step i: Endo-8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-ol

8-[(3,4-Dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-one (330mg) was dissolved in tetrahydrofuran (5ml) and cooled to 0°C. Lithium tris (3-ethylpentyl-3-oxy)aluminumhydride solution (0.5M, 2.5ml) was added dropwise and the mixture was allowed to attain room temperature overnight. Sodium sulfate decahydrate (ca 2g) was added and the suspension was stirred for 1 hour. The reaction mixture was diluted with ethyl acetate, filtered through kieselguhr and evaporated. The residue was purified by chromatography eluting with dichloromethane: methanol (9:1) to give the subtitle compound 161mg.

¹H NMR (399.978 MHz, CDCl₃) δ 1.59 (d, *J* = 8.1 Hz, 2H), 1.64 (t, *J* = 11.4 Hz, 2H), 1.86 - 1.81 (m, 2H), 2.00 - 1.97 (m, 2H), 3.21 - 3.18 (m, 2H), 3.55 (s, 2H), 3.95 (septet, *J* = 5.6 Hz, 1H), 7.21 (d, *J* = 8.2 Hz, 1H), 7.37 (d, *J* = 7.4 Hz, 1H), 7.50 (s, 1H).

Step ii: Exo-2-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-1*H*-isoindole-1,3(2*H*)-dione

Endo-8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-ol (556mg), phthalimide (321mg) and polymer bound triphenylphosphine (821mg) were combined in tetrahydrofuran (10ml). Diethylazodicarboxylate (330μl) was added and the mixture was

stirred gently overnight. Additional phosphine (0.5g) and diethylazodicarboxylate (200 μ l) were added and the mixture was stirred for an additional 5 days. The reaction mixture was diluted with ethyl acetate and filtered; the residue was washed with ethyl acetate and methanol. The filtrate was evaporated, and chromatographed eluting with 9:1 ethyl acetate : methanol. RPHPLC of the product (gradient ammonium acetate 1% aqueous : acetonitrile (25% acetonitrile to 100% acetonitrile)) gave the subtitle compound (90mg).
¹H NMR (399.978 MHz, CDCl₃) δ 1.47 - 1.39 (m, 2H), 1.78 (d, J = 7.7 Hz, 2H), 2.14 - 2.02 (m, 2H), 2.64 (t, J = 11.8 Hz, 2H), 3.36 - 3.25 (m, 2H), 3.92 - 3.81 (m, 2H), 4.56 (septet, J = 6.1 Hz, 1H), 7.41 - 7.32 (m, 2H), 7.59 - 7.55 (m, 1H), 7.74 - 7.69 (m, 2H), 7.86 - 7.82 (m, 2H).

Step iii: Exo-8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]octan-3-amine Exo-2-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-1*H*-isoindole-1,3(2*H*)-dione (90mg) was dissolved in ethanol (6ml) containing dichloromethane (3ml); hydrazine hydrate (0.2ml) was added and the resulting solution was stirred at room temperature for 26hours. The suspension was filtered and the filtrate was evaporated to give the subtitle compound (55mg).

¹H NMR (399.978 MHz, CDCl₃) δ 1.51 - 1.43 (m, 2H), 1.59 (q, J = 4.9 Hz, 2H), 1.75 - 1.67 (m, 2H), 2.00 - 1.94 (m, 2H), 3.02 - 2.92 (m, 1H), 3.18 - 3.12 (m, 2H), 3.50 (s, 3H), 7.21 (d, J = 8.2 Hz, 1H), 7.37 (d, J = 8.2 Hz, 1H), 7.50 (s, 1H).

Step iv: Exo-*N*-[8-[(3,4-dichlorophenyl)methyl]-8-azabicyclo[3.2.1]oct-3-yl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide

Prepared following the method of Example 370 step (iii) but without salt formation to give the title compound (15mg).

m.p. 177.5-178°C

¹H NMR (299.946 MHz, DMSO): δ 1.63 - 1.43 (m, 6H), 1.99 - 1.90 (m, 2H), 2.64 (t, J = 7.1 Hz, 2H), 3.11 - 3.06 (m, 2H), 3.18 (t, J = 6.2 Hz, 2H), 3.49 (s, 2H), 3.97 - 3.83 (m, 1H), 7.32 (dd, J = 8.3, 1.9 Hz, 1H), 7.62 - 7.56 (m, 3H), 7.87 (d, J = 8.1 Hz, 1H), 8.06 - 7.97 (m, 2H), 8.75 (dt, J = 3.7, 0.8 Hz, 1H).

Example 374

(R) *N*-[1-[1-(4-bromophenyl)ethyl]-4-piperidinyl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide

1H), 7.25 (d, J = 8.5 Hz, 2H), 7.49 (d, J = 8.5 Hz, 2H), 7.59 (ddd, J = 6.7, 4.6, 2.1 Hz, 1H), 7.91 (d, J = 7.4 Hz, 1H), 8.04 - 7.99 (m, 2H), 8.75 (dt, J = 4.4, 1.4 Hz, 1H).

Example 375

5 (S) *N*-[1-[1-(4-bromophenyl)ethyl]-4-piperidinyl]-3-(2-pyridinyl)-1,2,4-oxadiazole-5-propanamide

Prepared following an analogous series of steps to example 374 but using (S)-(4-bromophenyl)ethylamine to give the title compound.

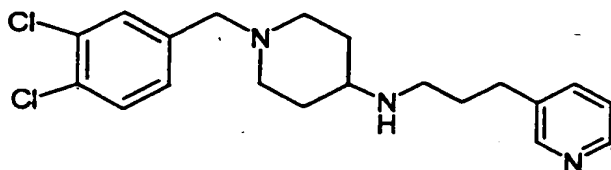
m.p. 141.5-143°C

10 $\alpha_D -29.55^\circ$ (c = 0.13, methanol, 21°C)

¹H NMR (299.946 MHz, DMSO) δ 1.23 (d, J = 6.7 Hz, 3H), 1.26 - 1.41 (m, 2H), 1.64 (t, J = 8.1 Hz, 2H), 1.92 (q, J = 11.2 Hz, 2H), 2.58 - 2.67 (m, 1H), 2.67 (t, J = 7.2 Hz, 2H), 2.78 - 2.85 (m, 1H), 3.18 (t, J = 7.1 Hz, 2H), 3.37 - 3.46 (m, 1H), 3.42 (q, J = 6.7 Hz, 1H), 7.25 (d, J = 6.7 Hz, 2H), 7.49 (d, J = 8.5 Hz, 2H), 7.57 - 7.62 (m, 1H), 7.91 (d, J = 7.7 Hz, 1H),
15 7.98 - 8.05 (m, 2H), 8.75 (d, J = 7.5 Hz, 1H).

Example 385

1-[3,4-Dichlorobenzyl]-*N*-[3-(3-pyridinyl)propyl]-4-piperidinamine



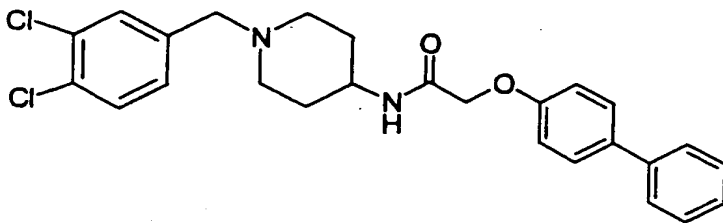
20 The title compound was prepared from 1-(3,4-dichlorobenzyl)piperidine-4-amine (free base 187mg), 3-(3-pyridinyl)propanal (125mg), sodium triacetoxyborohydride (70mg), and 0.02ml acetic acid, stirred together for 2hrs in dichloromethane (10ml). Water was added, the mixture neutralised with sodium bicarbonate and the organic phase separated, dried and chromatographed on silica with ethyl acetate/methanol (9:1) as eluant, to give the
25 title compound (70mg) as a colourless oil.

MS [M+H]⁺ (ES+) 378

$^1\text{H NMR}$: (CDCl_3) δ 1.36-1.40 (2H, m), 1.75-1.85 (4H m), 2.0 (2H, t), 2.1-2.2 (2H, m), 2.4-2.45 (1H m), 2.6-2.7 (3H, m), 2.75-2.79 (2H, m), 3.4 (2H, s), 7.1-7.54 (5H, d), 8.44 (2H, m).

5 **Example 386**

2-[(1,1'-Biphenyl)-4-yloxy]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]acetamide

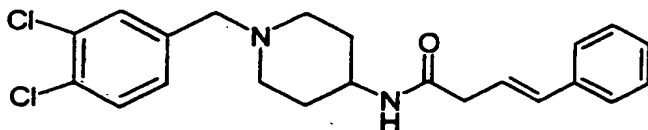


MS $[\text{M}+\text{H}]^+$ (ES+) 469

10 $^1\text{H NMR}$: (CDCl_3) δ 1.46-1.50 (2H, m), 1.7-1.8 (2H, m), 2.0-2.1 (2H, m), 2.5-2.6 (2H, m), 3.45 (2H, s), 3.65 - 3.7 (1H, m), 4.5 (2H, s), 7.25-7.3 (2H, m), 7.27-7.63 (9H, m), 8.0 (1H, d).

Example 387

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-4-phenyl-3-butenamide



15 MS $[\text{M}+\text{H}]^+$ (ES+) 403

$^1\text{H NMR}$: (CDCl_3) δ 1.46-1.40 (2H, m), 1.85-1.95 (2H, d), 2.05-2.15 (2H, t), 2.75-2.79 (2H, d), 3.1 (2H, d), 3.4 (2H, s), 3.85-3.95 (1H, m), 5.45 (1H, m), 6.3 (1H, m), 6.5 (1H, d), 7.07-7.43 (8H, m).

20

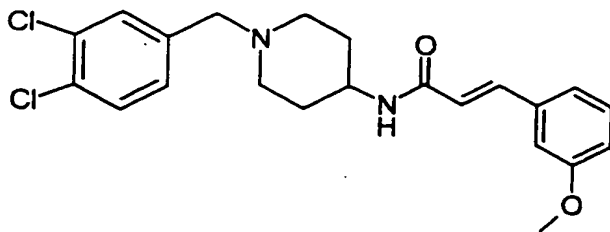
Example 388

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-(3-methoxyphenyl)-2-propenamide.

WO 01/14333

PCT/GB00/03179

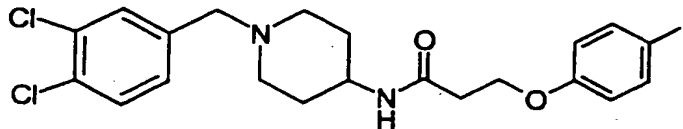
105

MS [M+H]⁺ (ES+) 419

¹H NMR: (CDCl₃) δ 1.46-1.50 (2H, m), 2.0 (2H, m), 2.15-2.25 (2H, m), 2.75-2.85 (2H, m), 3.4 (2H, s), 3.8 (3H, s), 3.94-4.05 (1H, m), 5.5 (1H, d), 6.35-6.4 (1H, d), 6.9-7.5 (7H, m), 7.6 (1H, d).

Example 389

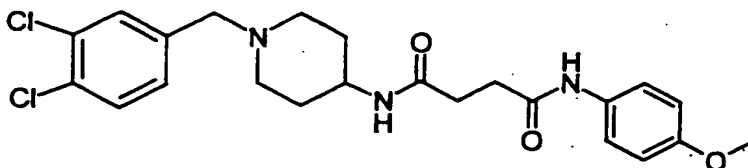
N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-(4-iodophenoxy)propanamide.

10 MS [M+H]⁺ (ES+) 533

¹H NMR: (CDCl₃) δ 1.46-1.50 (2H, m), 1.9 (2H, d), 2.1-2.2 (2H, t), 2.6 (2H, m), 2.75-2.85 (2H, d), 3.4 (2H, d), 3.8-3.9 (1H, m), 4.20 (2H, m), 6.65-6.7 (2H, m), 7.1-7.2 (1H, d), 7.35-7.45 (2H, m), 7.54-7.6 (2H, m).

15 **Example 390**

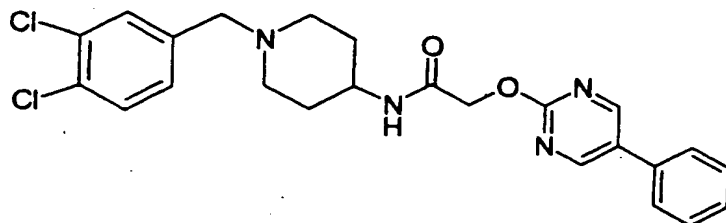
N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-N'-(4-methoxyphenyl)succinamide

MS [M+H]⁺ (ES+) 464

¹H NMR: (CDCl₃) δ 1.4 (2H, m), 1.6-1.65 (2H, m), 2.05 (2H, m), 2.45 (2H, m), 2.65-2.75 (2H, m), 3.0 (2H, m), 3.45 (2H, s), 3.5 (1H, m), 3.7 (3H, s), 5.9 (1H, m), 6.85 (2H, d), 7.3-7.6 (4H, m), 7.7 (1H, d), 9.7 (1H, s).

Example 391

N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[(5-phenyl-2-pyrimidinyl)oxy] acetamide

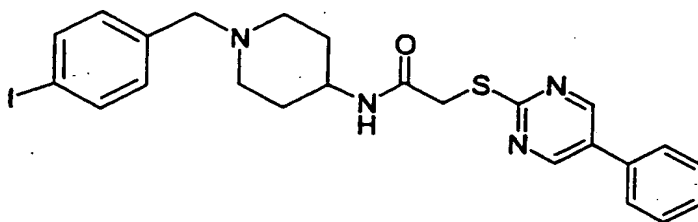


5 MS [M+H]⁺ (ES+) 471

¹H NMR: (CDCl₃) δ 1.46-1.50 (2H, m), 1.9-2.0 (2H, m), 2.0-2.1 (2H, m), 2.75-2.85 (2H, m), 3.4 (2H, s), 3.9- 4.0 (1H, m), 4.92 (2H, s), 6.53 (1H, d), 7.1-7.6 (7H, m), 7.7 (1H, s), 8.76 (2H, s).

10 **Example 392**

N-[1-(4-iodobenzyl)-4-piperidinyl]-2-(5-phenyl-2-pyrimidinylthio)acetamide

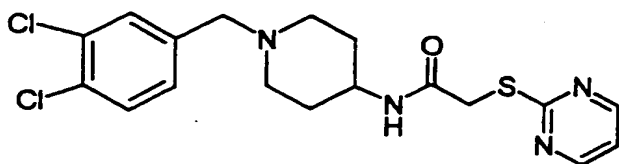


MS [M+H]⁺ (ES+) 545

15 ¹H NMR: (CDCl₃) δ 1.46-1.50 (2H, m), 1.8 (2H, m), 2.1-2.2 (2H, t), 2.65 (2H, m), 3.4 (2H, s), 3.9(3H, m), 6.8 (1H, d), 7.0 (2H, m), 7.5-7.7 (7H, m), 8.8 (2H, d).

Example 393

N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-[(2-pyrimidinyl)thio]acetamide

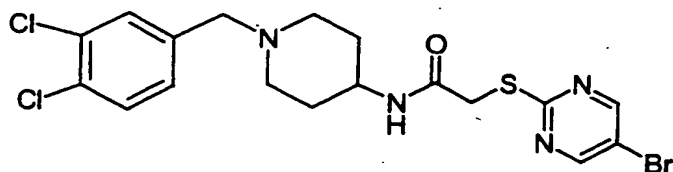


20 MS [M+H]⁺ (ES+) 412

$^1\text{H NMR}$: (CDCl_3) δ 1.46-1.50 (2H, m), 1.8 (2H, m), 2.1 (2H, m), 2.65 (2H, m), 3.4 (2H, s), 3.8 (3H, m), 6.90 (1H, m), 7.05-7.2 (4H, m), 8.58 (2H, d).

Example 394

5 2-[(5-Bromo-2-pyrimidinyl)thio]-N-[1-(3,4-dichlorobenzyl)-4-piperidiny]acetamide



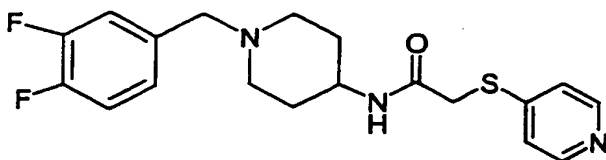
MS $[M+H]^+$ (ES+) 491

$^1\text{H NMR}$: (CDCl_3) δ 1.46 - 1.50 (2H, m), 1.8 (2H, m), 2.15 (2H, m), 2.6 (2H, m), 3.4 (2H, s), 3.8 (3H, m), 6.6 (1H, d), 7.1 (1H, m), 7.3-7.4 (2H, m) 8.58 (2H, d).

10

Example 395

N-[1-(3,4-difluorobenzyl)-4-piperidiny]-2-(4-pyridinylthio)acetamide

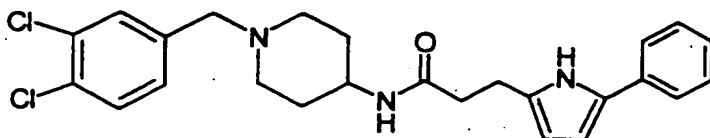


MS $[M+H]^+$ (ES+) 378

15 $^1\text{H NMR}$: (CDCl_3) δ 1.36 - 1.40 (2H, m), 1.8 (2H, m), 2.05 (2H, m), 2.65 (2H, m), 3.4 (2H, m), 3.67 (2H, s), 3.8 (1H, m), 6.5 (1H, m), 6.9-7.24 (4H, m) 8.48 (2H, d).

Example 396

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-(5-phenyl-1H-pyrrol-2-yl)propanamide



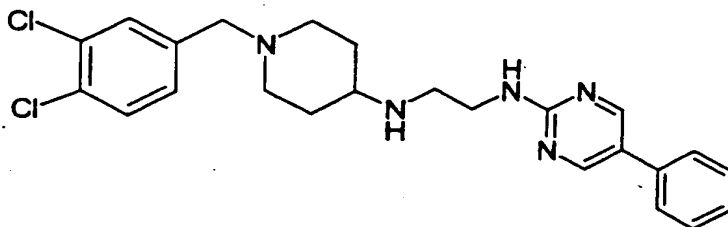
20

MS $[M+H]^+$ (ES+) 454

¹H NMR: (CDCl₃) δ 1.36-1.40 (2H, m), 1.87 (2H, m), 2.05 (2H, m), 2.5 (2H, m), 2.65 (2H, m), 2.96 (2H, m), 3.4 (2H, s), 3.8 (1H, m), 5.35 (1H, d), 5.95-6.0 (1H, m) 6.38 (1H, m), 7.1-7.5 (8H, m), 9.5 (1H, m).

5 **Example 397**

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-N'-(5-phenyl-2-pyrimidinyl)-1,2-ethandiamine



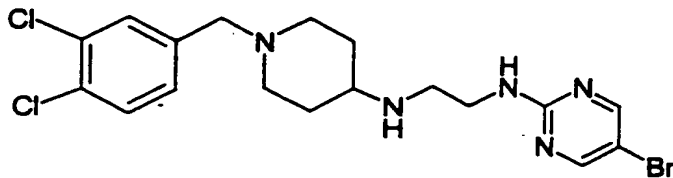
The title compound (20mg) was prepared by heating at reflux *N*'-[1-(3,4-dichlorobenzyl)-4-piperidiny]-1,2-ethanediamine (100mg) and 2-chloro-5-phenylpyrimidine (100mg) and Hunigs' base (100mg) in toluene for 8 hours. The mixture was purified by chromatography on silica, with ethyl acetate methanol (9:1) as eluant to give the title compound as a yellow oil.

MS [M+H]⁺ (ES+) 456/8

15 ¹H NMR: (CDCl₃) δ 1.51 (2H, m), 1.75 (2H, m), 2.15 (2H, td), 2.9 (2H, m), 3.05 (1H, m), 3.15 (2H, m), 3.44 (2H, m), 3.8 (2H, m), 6.65 (1H, m), 7.0-7.4 (8H, m), 8.5 (2H, m).

Example 398

20 **N-[5-bromo-2-pyrimidinyl]-N'-[1-(3,4-dichlorobenzyl)-4-piperidiny]-1,2-ethandiamine**



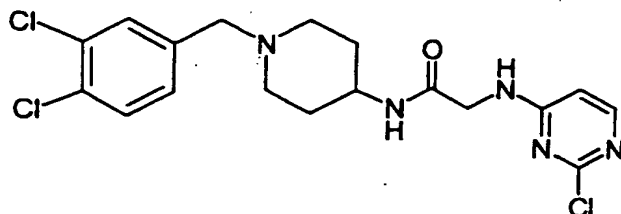
Prepared by the method of Example 397 amine (200mg), 2-chloro-5-bromopyrimidine (130mg), Hunigs' base (200mg) to give the title compound (20mg).

MS [M+H]⁺ (ES+) 458/60

$^1\text{H NMR}$: (CDCl_3) δ 1.4 (2H, m), 1.75 (2H, m), 2.05 (2H, td), 2.85 (2H, m), 3.0 (1H, m), 3.15 (2H, m), 3.44 (2H, m), 3.75 (2H, m), 6.8 (1H, m), 7.0-7.4 (3H, m), 8.25 (2H, m).

Example 399

5 2-[(2-Chloro-4-pyrimidinyl)amino]-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]acetamide

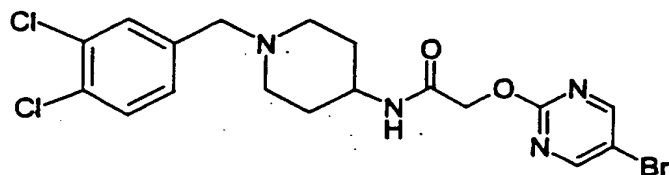


MS $[\text{M}+\text{H}]^+$ (ES+) 430/32

$^1\text{H NMR}$: (CDCl_3) δ 1.40 -1.45 (2H, m), 1.97 (2H, m), 2.15 (2H, m), 2.75 (2H, d), 3.4 (2H, s), 3.8 (1H, m), 4.05 (2H, d), 5.75 (1H, d), 5.84 (1H, m), 6.38 (1H, d), 7.1-7.15 (1H d), 7.36-7.42(2H m), 8.0 (1H d).

Example 401

15 2-[(5-Bromo-2-pyrimidinyl)oxy]-N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-acetamide



MS $[\text{M}+\text{H}]^+$ (ES+) 475

$^1\text{H NMR}$: (CDCl_3) δ 1.46-1.50 (2H, m), 1.87 (2H, m), 2.15 (2H, m), 2.75 (2H, m), 3.4 (2H, s), 3.9 (1H, m) 4.8 (2H, s), 6.38 (1H, d), 7.1-7.15 (1H m), 7.4 (2H, m), 8.6 (2H, s).

20

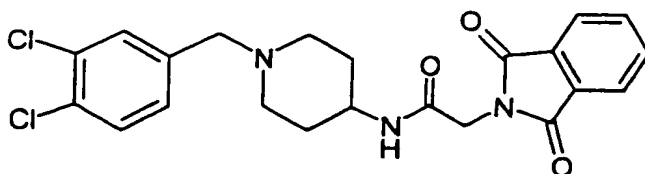
Example 402

N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(1,3-dioxo-1,3-dihydro-2H-isoindol-2-yl)acetamide

WO 01/14333

PCT/GB00/03179

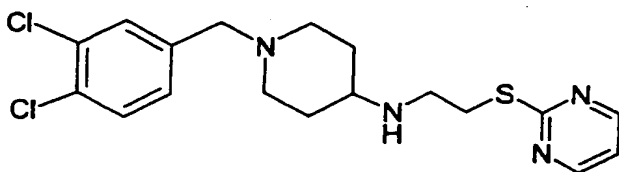
110

MS [M+H]⁺ (ES+) 446

¹H NMR: (CDCl₃) δ 1.46-1.50 (2H, m), 1.87 (2H, m), 2.15 (2H, m), 2.75 (2H, m), 3.4 (2H, s), 3.8 (1H, m), 4.3 (2H, s), 5.65 (1H, m), 7.1-7.36 (3H, m) 7.38-7.78 (2H, m), 7.87-7.95 (2H, m).

Example 403

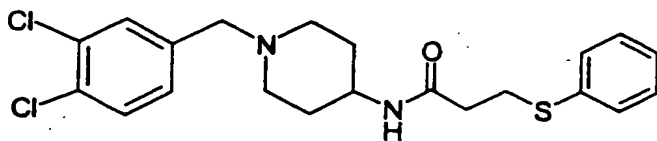
N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-N-[2-(2-pyridinylthio)ethyl]amine, dihydrochloride



¹H NMR: (CDCl₃) (of the free base): δ 1.4 (2H, m) 1.85 (2H, m), 2.05 (2H, m) 2.55 (2H, td), 2.8 (2H, m), 3.0 (1H, m), 3.3 (2H, m), 3.42 (2H, s), 6.9-7.5 (4H, m), 8.5 (2H, m).

Example 404

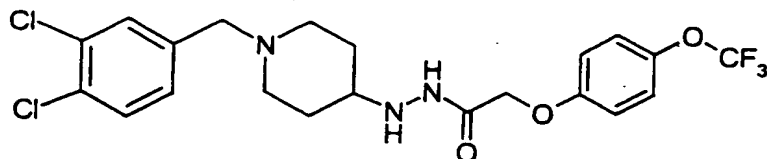
N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-3-(phenylthio)propanamide

MS [M+H]⁺ (ES+) 423

¹H NMR: (CDCl₃) δ 1.36-1.40 (2H, m), 1.87 (2H, m), 2.15 (2H, m), 2.45 (2H, m), 2.76 (2H, m), 3.2 (2H, m), 3.4 (2H, s), 3.8 (1H, m), 5.4 (1H, d), 7.1-7.5 (8H, m).

Example 405

N'-[1-(3,4-dichlorobenzyl)-4-piperidiny]-2-[4-(trifluoromethoxy)phenoxy]acetohydrazide



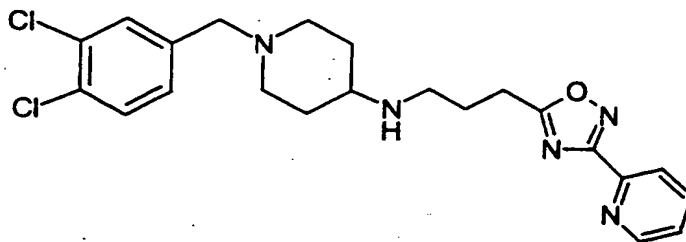
The title compound was prepared from 3,4-dichlorobenzyl-4-piperidone (J. Med. Chem, 1999, 42, 3629; 100mg), 2-[4(trifluoromethoxy)phenoxy]aceto-hydrazide (100mg), sodium triacetoxyborohydride (100mg), and 0.02ml acetic acid, stirred together for 2hours in dichloromethane by the method of Example 369 step ii.

MS [M+H]⁺ (ES+) 492

¹H NMR: (CDCl₃) δ 1.4–1.6 (3H, m) 1.7 (2H, m), 2.0 (2H, m) 2.7–2.9 (2H, m), 3.4 (2H, m), 4.4 (3H, m), 5.3 (1H, s) 6.9 (2H, m), 7.2–7.5 (4H, m), 7.8 (1H, d).

10 **Example 406**

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-N-[3-[3-(2-pyridiny)-1,2,4-oxadiazol-5-yl]propyl]amine



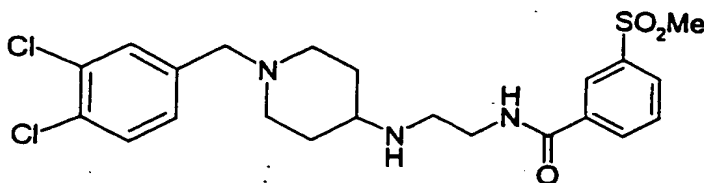
The title compound (29mg) was prepared from 3,4-dichlorobenzylpiperidine-4-amine (100mg free base), 2-[5-(3-bromopropyl)-1,2,4-oxadiazol-3-yl]pyridine (100mg), potassium carbonate (100mg) in dimethyl formamide (1ml) were heated together in the microwave for 30secs, water was added and the product extracted into dichloromethane and chromatographed on silica with ethyl acetate/methanol(9:1) as eluant.

MS [M+H]⁺ (ES+) 446

20 ¹H NMR: (CDCl₃) δ 1.4 (2H, m) 1.7–1.9 (4H, m), 2.0–2.1 (4H, m) 2.46 (1H, m), 2.75 (2H, m), 3.1 (2H, t), 3.4 (2H, s), 7.15–7.45 (4H, m), 7.85(1H, t) 8.1 (1H, d) 8.8 (1H, d).

Example 407

N-[2-[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino]ethyl]-3-(methylsulphonyl)benzamide



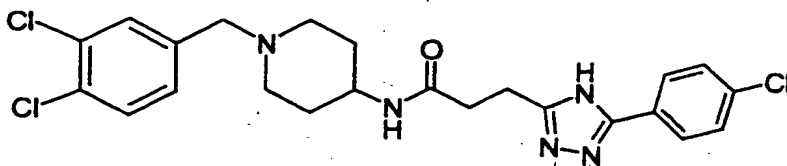
Prepared from *N*-(2-aminoethyl)-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2,2,2-trifluoroacetamide (100mg), 3-methylsulphonylbenzoic acid (50mg) and carbonyldiimidazole (40mg). The product obtained was stirred together with sodium hydroxide (40mg) in 50:50 methanol/ water for 12hrs, extracted into dichloromethane and purified by chromatography on silica with ethyl acetate/methanol (9:1) as eluant, to give the title compound (25mg).

MS [M+H]⁺ (ES+) 485

¹H NMR: (CDCl₃) δ 1.4 (2H, m) 1.9 (2H, m), 2.0-2.1 (1H, m) 2.6 (1H, m), 2.8 (2H, m), 2.95 (2H, m) 3.1 (3H, m) 3.4 (2H, s), 3.6 (2H, m), 7.15 (2H, m), 7.4 (2H, m), 7.65(1H, t) 8.1 (2H d) 8.4 (1H, d).

Example 408

3-[5-(4-chlorophenyl)-4H-1,2,4-triazol-3-yl]-*N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]propanamide

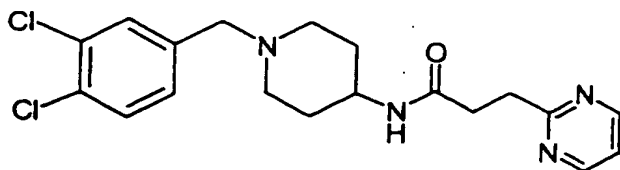


MS [M+H]⁺ (ES+) 493

¹H NMR: (CDCl₃) δ 1.6 (2H, m), 1.87 (2H, m), 2.25 (2H m), 2.65 (2H, m), 2.86 (2H, m), 3.14 (2H, m), 3.5 (2H, s), 3.85 (1H, m), 6.0 (1H, m) 7.23 (1H, m), 7.4 (3H m), 7.45 (1H m), 8.0 (2H m).

Example 409

***N*-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-3-(2-pyridinyl)propanamide**

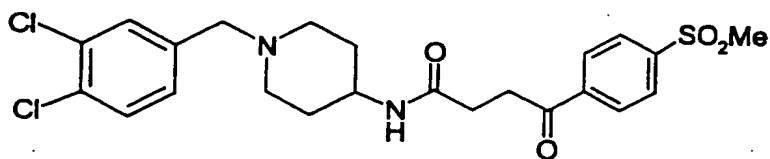


MS [M+H]⁺ (ES+) 394

¹H NMR: (CDCl₃) δ 1.46 (2H, m), 1.8 (2H, m), 2.15 (2H, m), 2.75 (4H, m), 3.3 (2H, m), 3.45 (2H, s), 3.8 (1H, m), 6.05 (1H, m), 7.1 (2H, m) 7.38 (1H, m), 7.45 (1H, m), 8.65 (2H, m)

Example 410

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-4-(4-(methylsulphonyl)phenyl)-4-oxobutanamide

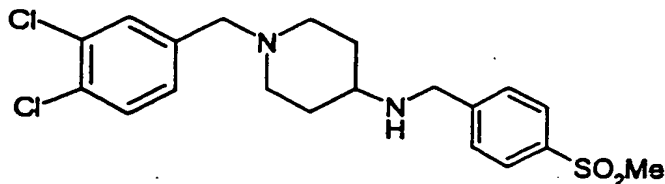


MS [M+H]⁺ (ES+) 497

¹H NMR: (CDCl₃) δ 1.4-1.5 (2H, m), 1.9 (2H, m), 2.15 (2H, m), 2.65 (2H, m), 2.78 (2H, m), 3.1 (3H, s), 3.35 (2H, m), 3.4 (2H, s), 3.8 (1H, m), 5.55 (1H, m), 7.16 (1H, m) 7.38 (2H, m), 8.05 (2H, m), 8.2 (2H, m).

Example 411

N-[1-(3,4-dichlorobenzyl)-4-piperidiny]-N'-[4-(methylsulphonyl) benzylamine]

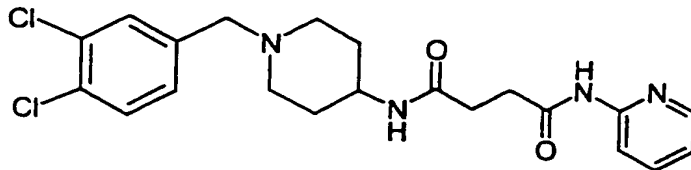


MS [M+H]⁺ (ES+) 427

¹H NMR: (CDCl₃) δ 1.4 (2H, m), 1.8-1.9 (2H, m), 2.0 (2H, m), 2.5 (2H, td), 2.8 (2H, m), 3.0 (2H, s), 3.4 (2H, s), 3.94 (2H, s), 7.15 (1H, m), 7.4 (2H, m), 7.55 (2H, d) 7.9 (2H, d).

Example 412

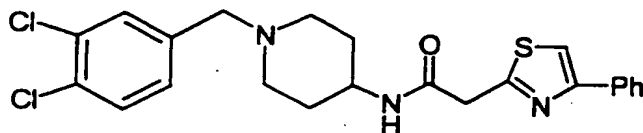
N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-N'-[(2-pyridinyl) succinamide]

MS [M+H]⁺ (ES+) 435

5 ¹H NMR: (CDCl₃) δ 1.6 (2H, m), 1.87 (2H, m), 2.05 (2H, m), 2.65 (2H, m), 2.76 (4H, m), 3.4 (2H, s), 3.8 (1H, m), 5.65 (1H, m), 7.0 (1H, m), 7.1 (1H, m), 7.38 (2H, d), 7.7 (1H, m), 8.2 (1H, m), 8.27 (1H, m), 8.65 (1H, m).

Example 413

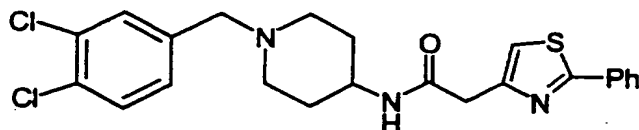
10 N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(4-phenyl-1,3-thiazol-2-yl)acetamide

MS [M+H]⁺ (ES+) 461

15 ¹H NMR: (CDCl₃) δ 1.50 (2H, m), 1.87 (2H, m), 2.15 (2H, m), 2.65 (2H, m), 3.4 (2H, s), 3.85 (1H, m), 4.0 (2H, s), 7.15 (1H, d) 7.3-7.5 (6H, m), 7.9 (2H, d).

Example 414

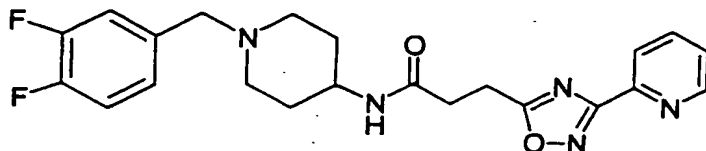
N-[1-(3,4-dichlorobenzyl)-4-piperidinyl]-2-(2-phenyl-1,3-thiazol-4-yl)acetamide

MS [M+H]⁺ (ES+) 461

20 ¹H NMR: (CDCl₃): δ 1.45 (2H, m), 1.90 (2H, m), 2.15 (2H, m), 2.65 (2H, m), 3.25 (2H, s), 3.7 (2H, s), 3.85 (1H, m), 7.15 (2H, m) 7.4 (2H, d), 7.5 (3H, m), 8.0 (2H, m).

Example 415

N-[1-(3,4-difluorobenzyl)-4-piperidiny]-3-(3-2-pyridinyl-1,2,4-oxadiazol-5-yl)propanamide

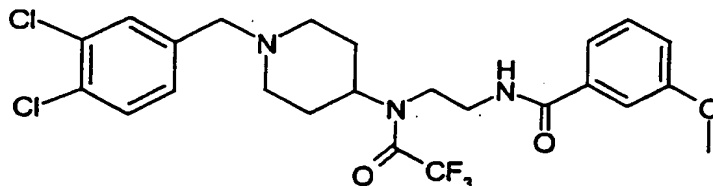


MS $[M+H]^+$ (ES+) 428

5 1H NMR: (CDCl₃) δ 1.36-1.45 (2H, m), 2.0 (2H, m), 2.1-2.2 (2H, t), 2.7-2.85 (4H, m), 3.34 (2H, d), 3.4(2H, d), 3.8 (1H, m), 5.6 (1H, d), 7.0-7.2 (3H m), 7.4 (1H m), 7.8 (1H, m) 8.1 (1H, d), 8.8 (1H, d)

Example 416

10 **N-trifluoroacetyl-N-[2-[1-(3,4-dichlorobenzyl)-4-piperidiny]amino]ethyl]-3-methoxybenzamide**



a) *tert*-butyl 2-[[1-(3,4-dichlorobenzyl)-4-piperidiny]amino]ethylcarbamate

The sub-title compound (800mg) was prepared from 3,4-dichlorobenzyl-4-piperidone
 15 (1.3g) *tert*-butyl 2-aminoethylcarbamate (0.8g), sodium triacetoxyborohydride (100mg), and 0.02ml acetic acid, stirred together for 2hrs in dichloromethane. The sub-titled compound was isolated by standard procedures.

MS $[M+H]^+$ (ES+) 402

b) *N*-(2-aminoethyl)-*N*-[1-(3,4-dichlorobenzyl)-4-piperidiny]-2,2,2-trifluoroacetamide

20 A mixture of the above amine (800mg), and triethylamine (0.5ml) in dichloromethane (50ml), treated with trifluoroacetic anhydride (420mg) over 30 mins, evaporated to dryness and dichloromethane(20ml) and trifluoroacetic acid (2ml) added, stirred for 3hrs, then neutralised with aqueous sodium bicarbonate, the organic phase separated, dried and evaporated to give the title compound (250mg) as a yellow oil.

25 MS $[M+H]^+$ (ES+) 496/8

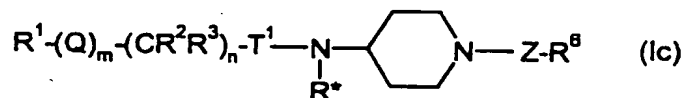
c) **N-trifluoroacetyl-N-[2-[1-(3,4-dichlorobenzyl)-4-piperidinyl]amino]ethyl]-3-methoxybenzamide**

The title compound (30mg) was prepared from the product above (40mg) 3-methoxybenzoyl chloride (20mg) and triethylamine (50mg) using one of the methods described above.

MS [M+H]⁺ (ES+) 580

¹H NMR: (CDCl₃) δ 0.9 (6H, m) 1.2-1.4 (6H, m), 1.6-1.85 (4H, m) 2.8 (1H, m), 3.3 (4H, m), 3.6-3.8 (5H, m), 3.8 (2H, s), 7.0 (1H, m), 7.1 (1H, m), 7.35-7.45 (3H, m), 8.25(1H, t).

10 Further compounds of formula (I), all according to formula (Ic), are shown in the table below.



Example	R ¹	(Q) _m	(CR ² R ³) _n	T ¹	R [*]	Z	R ^b
380	4-Cl-C ₆ H ₄	O	CH ₂	C(O)	H	CH ₂ C (O)NH	2-Cl-5- CH ₃ -C ₆ H ₃
381	4-Cl-C ₆ H ₄	O	CH ₂	C(O)	H	(CH ₂) ₃	C ₆ H ₅
382	3-(pyridin-2-yl)- 1,2,4-oxadiazol-5-yl	O	CH ₂	C(O)	H	allyl	C ₆ H ₅
383	2-(cyclopropyl-NH)- pyrimidin-4-yl	m=0	n=0	-	CH ₃	CH ₂	3,4-Cl ₂ - C ₆ H ₃
384	2-(pyridin-3-yl)- pyrimidin-4-yl	m=0	n=0	-	CH ₃	CH ₂	3,4-Cl ₂ - C ₆ H ₃
400	pyrimidin-2-yl	S	CH ₂	C(O)	H	C(O)	3,4-Cl ₂ - C ₆ H ₃

Pharmacological Analysis

15 **Calcium flux [Ca²⁺]_i assay**

a) Human eosinophils

Human eosinophils were isolated from EDTA anticoagulated peripheral blood as previously described (Hansel et al., *J. Immunol. Methods*, 1991, 145, 105-110). The cells

were resuspended ($5 \times 10^6 \text{ ml}^{-1}$) and loaded with $5 \mu\text{M}$ FLUO-3/AM + Pluronic F127 $2.2 \mu\text{l/ml}$ (Molecular Probes) in low potassium solution (LKS; NaCl 118mM, MgSO_4 0.8mM, glucose 5.5mM, Na_2CO_3 8.5mM, KCl 5mM, HEPES 20mM, CaCl_2 1.8mM, BSA 0.1%, pH 7.4) for one hour at room temperature. After loading, cells were centrifuged at 200g for 5min and resuspended in LKS at $2.5 \times 10^6 \text{ ml}^{-1}$. The cells were then transferred to 96 well FLIPr plates (Poly-D-Lysine plates from Becton Dickinson pre-incubated with $5 \mu\text{M}$ fibronectin for two hours) at 100ml/well. The plate was centrifuged at 200g for 5min and the cells were washed twice with LKS (200 μl ; room temperature).

A compound of the Examples was pre-dissolved in dimethylsulphoxide and added to a final concentration of 0.1%(v/v) dimethylsulphoxide. Assays were initiated by the addition of an A_{50} concentration of eotaxin and the transient increase in fluo-3 fluorescence ($I_{\text{Ex}} = 490\text{nm}$ and $I_{\text{Em}} = 520\text{nm}$) monitored using a FLIPR (Fluorometric Imaging Plate Reader, Molecular Devices, Sunnyvale, U.S.A.).

15 **b) Human monocytes**

Human monocytes were isolated from EDTA anticoagulated peripheral blood as previously described (Cunoosamy & Holbrook, J. Leukocyte Biology, 1998, S2, 13). Cells were resuspended ($5 \times 10^6 \text{ ml}^{-1}$) in LKS and loaded with $5 \mu\text{M}$ FLUO-3/AM + Pluronic F127 $2.2 \mu\text{l/ml}$ (Molecular Probes) for one hour at room temperature. After loading, cells were centrifuged at 200g for 5min and resuspended in LKS at $0.5 \times 10^6 \text{ ml}^{-1}$. The cells were then transferred to 96 well FLIPr plates (Costar). To each well 100 μl of cells were added at a concentration of $0.5 \times 10^6 \text{ ml}^{-1}$. The plates were centrifuged (200g; 5 mins; room temperature) to allow the cells to adhere. After centrifugation the cells were washed twice with LKS (200 μl ; room temperature).

25 A compound of the Examples was pre-dissolved in dimethylsulphoxide and added to a final concentration of 0.1%(v/v) dimethylsulphoxide. Assays were initiated by the addition of an A_{50} concentration of MIP-1 α and the transient increase in fluo-3 fluorescence ($I_{\text{Ex}} = 490\text{nm}$ and $I_{\text{Em}} = 520\text{nm}$) monitored using a FLIPR (Fluorometric Imaging Plate Reader, Molecular Devices, Sunnyvale, U.S.A.).

The compounds of the Examples were found to be antagonists of the eotaxin mediated $[Ca^{2+}]_i$ in human eosinophils and/or antagonists of the MIP-1 α mediated $[Ca^{2+}]_i$ in human monocytes.

5 Human eosinophil chemotaxis

Human eosinophils were isolated from EDTA anticoagulated peripheral blood as previously described (Hansel et al., *J. Immunol. Methods*, 1991, 145, 105-110). The cells were resuspended at $10 \times 10^6 \text{ ml}^{-1}$ in RPMI containing 200 IU/ml penicillin, 200 $\mu\text{g/ml}$ streptomycin sulphate and supplemented with 10% HIFCS, at room temperature.

10 Eosinophils (700 μl) were pre-incubated for 15 mins at 37° C with 7 μl of either vehicle or compound (100x required final concentration in 10% dimethylsulphoxide). The chemotaxis plate (ChemoTx, 3 μm pore, Neuroprobe) was loaded by adding 28 μl of a concentration of eotaxin (0.1 to 100nM) containing a concentration of a compound according to the Examples or solvent to the lower wells of the chemotaxis plate. The filter
15 was then placed over the wells and 25 μl of eosinophil suspension were added to the top of the filter. The plate was incubated for 1 hr at 37° C in a humidified incubator with a 95% air/5% CO₂ atmosphere to allow chemotaxis.

The medium, containing cells that had not migrated, was carefully aspirated from above the filter and discarded. The filter was washed once with phosphate buffered saline
20 (PBS) containing 5 mM EDTA to remove any adherent cells. Cells that had migrated through the filter were pelleted by centrifugation (300xg for 5 mins at room temperature) and the filter removed and the supernatant transferred to each well of a 96-well plate (Costar). The pelleted cells were lysed by the addition of 28 μl of PBS containing 0.5% Triton x100 followed by two cycles of freeze/thawing. The cell lysate was then added to
25 the supernatant. The number of eosinophils migrating was quantified according to the method of Strath et al., *J. Immunol. Methods*, 1985, 83, 209 by measuring eosinophil peroxidase activity in the supernatant.

Certain compounds of the Examples were found to be antagonists of the eotaxin mediated human eosinophil chemotaxis.